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AMERICAN MACHINIST

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Plain Milling Machine.

We present herewith an illustration of a plain milling machine made by the Lodge & Davis Machine Tool Co., Cincinnati, Ohio. As will be seen, the machine conforms in its general features to the standard knee form of machine, has its uprights tied together above the cone pulley, and has an overhanging arm for supporting the outer end of the mill arbor.

The table is provided with an oil channel running around it, and drainage tubes are provided at each end for running the oil into vessels, which can be hung upon hooks provided for the purpose.

All the traversing screws are provided with micrometer graduations, and the rings are secured in place by knurled nuts, so they are very readily adjusted without the use of tools.

There is a quick return motion for the table, this being at the right of the machine, and operated by a fixed crank.

The automatic stop for the feed operates in either direction, and is placed in a T-slot, which also receives the auxiliary dog for hand-feeding.

A new device is provided, which is adjusted by a slotted screw, and takes up all lost motion in the traversing screws.

The feed is reversible by tumbler gearing, and has a range of .008 inch to .1 inch per revolution of spindle. The lower feed cone is mounted upon a swiveling yoke by means of which it can be adjusted to keep both feed belts at proper tension. A double-friction countershaft accompanies the machine.

The feed of the table is 24 inches; movement of table in line with spindle, 7 inches; vertical movement of knee, 19 inches.

It seems that if the New York Central Railroad owns the earth around New York, it does not own the heavens, nor even the river. Consequently, when Mr. Chauncey Depew advises that the North River Bridge cannot have a landing in New York between Fifty ninth and Seventy-second streets, because the Central owns all the river front there, the reply of the bridge company is, in effect, that they will cross one hundred and fifty feet above *terra firma*, which is, luckily, out of the great railroad's jurisdiction. It is rather evident that the New York Central is not always to be "The only railroad that enters New York City."

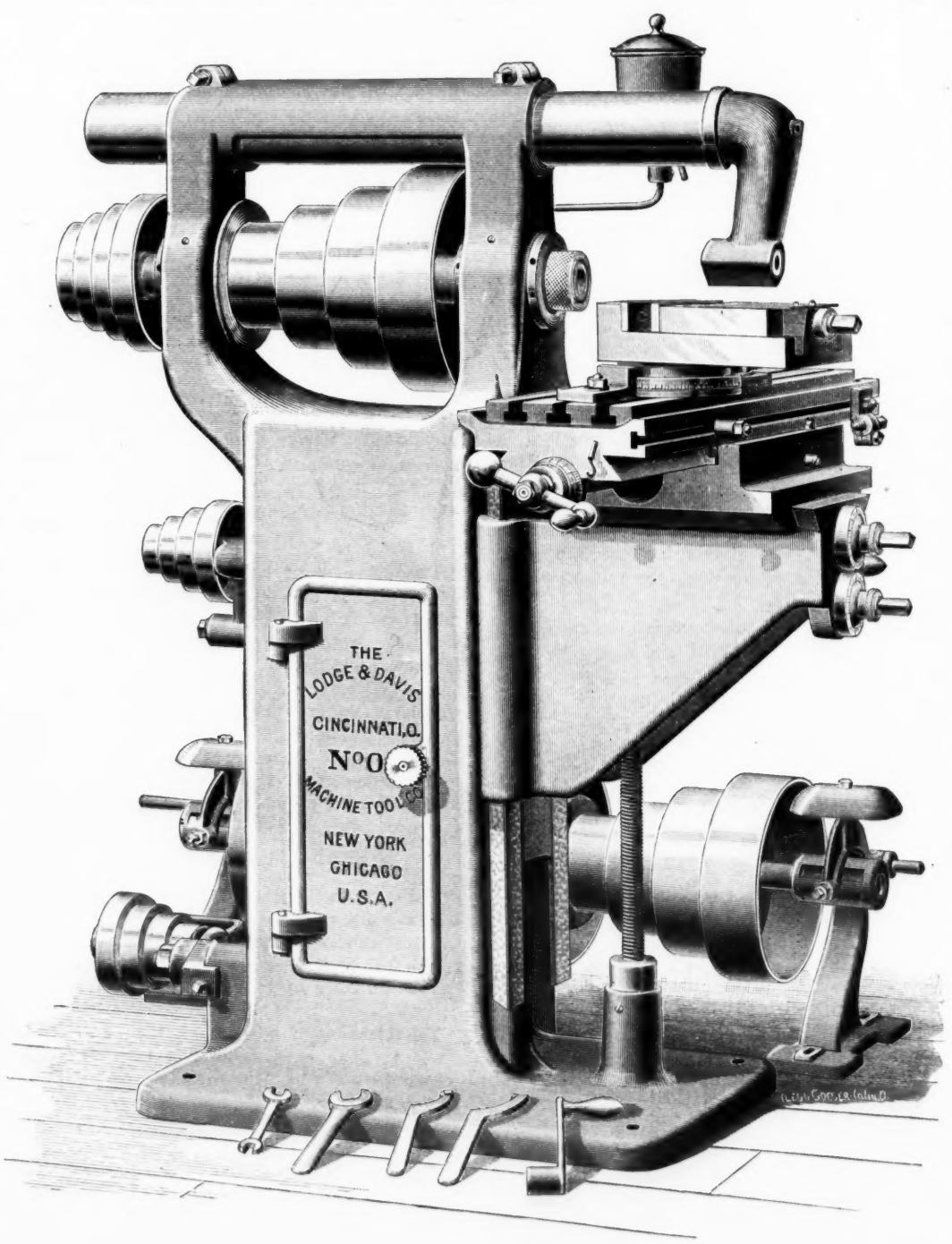
Passengers on an electric car route have been horrified, so a daily paper says, by the sight of a strong woman wielding the sledge for her husband in a little blacksmith shop. That was just what the wife of a man who was afterwards one of the great iron manufacturers of this country used to do before his more prosperous days, and she went barefoot in the summer, at that.

Comparison of Different Formulæ for Dimensions of Parts of Steam Engines.—I.

By William Kent, M. E.

The writer has had occasion to study the formulæ for dimensioning of parts of steam engines given by different writers, especially those given by Rankine, Thurston, Marks, Whitham and Seaton. For the purpose of making a comparison of the formulæ it was considered advisable to test them by applying them to several assumed cases covering a very wide range of sizes. Three diameters of cylinder were selected, viz.: 10, 30 and 50 inches, with indicated horse-powers, for about the most economical load, of 50, 450 and 1,250. A short-stroke and a long-stroke engine of each size were taken, the short-stroke having a length about equal to the diameter, and the long-stroke a length about equal to two diameters.

The results of these tests of the different formulæ showed in many cases a wide divergence; thus, for thickness of cylinder of the 10-inch engine, they range from .33 to 1.13 inches, and of the 50 inch engine from 1.56 to 3 inches; for thickness of cylinder head of the same engines the range is from .30 to 1.15 inches, and from 1.50 to 2.75 inches.



Plain Milling Machine.

The principal formulæ and the results of the study in condensed form are given below. Many formulæ which are not given below were rejected during the study, either as practical duplications of other formulæ given in other forms, or because they gave results far outside of the range of probability.

Cylinder—Whitham gives the following:

Length of bore = stroke + breadth of piston ring — ⅛ to ¼ inch. Length between heads = stroke + thickness of piston + sum of clearances at both ends. Thickness of piston = breadth of ring + thickness of flange on one side to carry the ring + thickness of follower plate.

	Inches.	Inches.	Inches.
Thickness of flange or follower	⅜ to ½	¾	1
For cylinder of diameter	8 to 10	36	60 to 100

Clearance of Piston (Seaton)—The clearance allowed varies with the size of the engine from ¼ to ⅜ inch for roughness of castings and $\frac{1}{16}$ to ⅛ inch for each working joint. Naval and other very fast running engines have a larger allowance. In a vertical direct-acting engine the parts which wear so as to bring the piston nearer the bottom are three, viz., the shaft journals, the crank-pin brasses, and piston rod gudgeon brasses, so that in a large engine we would allow at the top a clearance of ⅜ inch for the roughness of castings, and at the bottom an equal amount + ⅜ inch for wear of three working joints, or ¾ inch in all, making a total cylinder clearance of 1⅛ inches.

Thickness of Cylinder (Thurston). For engines of the older types and under moderate steam pressures, some builders have for many years restricted the stress to about 2,550 pounds on the square inch, and

$$t = a\,p_1\,d + b \qquad (1)$$

is a common proportion; t, d and b being thickness, diameter, and a constant added quantity varying from 0 to ½ inch, all in inches; p_1 is the initial unbalanced steam pressure per square inch. In this expression b is made larger for horizontal than for vertical cylinders, as, for example, in large engines 0.5 in the one case and 0.2 in the other, the one requiring re-boring more than the other. The constant a is from 0.0004 to 0.0005; the first value for vertical cylinders, or short strokes; the second for horizontal engines, or for long strokes.

Thickness of Cylinder and its Connections for Marine Engines—Seaton gives the following rules, *Marine Engineering*, p. 136:

d = the diameter of the cylinder in inches.

p = load on the safety valves in pounds per square inch.

f, a constant multiplier = thickness of barrel + .25 inch.

Thickness of metal of cylinder barrel or liner, not to be less than $p \times d \div 3{,}000$ when of cast-iron.* (2)

Thickness of cylinder barrel

$$= \frac{p \times d}{5{,}000} + 0.6 \text{ inch.} \qquad (3)$$

Thickness of liner $= 1.1 \times f$. (4)

Thickness of liner when of steel $p \times d \div 6{,}000 + 0.5$.

Thickness of liner metal of steam ports $= 0.6 \times f$.

Thickness of liner metal of valve-box sides $= 0\,65 \times f$.

Thickness of liner metal of valve-box covers $= 0.7 \times f$.

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* When made of exceedingly good material, at least twice melted, the thickness may be 0.8 of that given by the above rules.

Thickness of liner metal of cylinder bottom $= 1.1 \times f$, if single thickness.

Thickness of liner metal of cylinder bottom $= 0.65 \times f$, if double thickness.

Thickness of liner metal of cylinder covers $= 1.0 \times f$, if single thickness.

Thickness of liner metal of cylinder covers $= 0.6 \times f$, if double thickness.

Thickness of liner cylinder flange covers $= 1.4 \times f$.

Thickness of liner cylinder cover flange $= 1.3 \times f$.

Thickness of liner cylinder valve-box flange $= 1.0 \times f$.

Thickness of liner cylinder door flange $= 0.9 \times f$.

Thickness of liner cylinder face over ports $= 1.2 \times f$.

Thickness of liner cylinder face over ports $= 1.0 \times f$, when there is a false face.

Thickness of liner cylinder false face $= 0.8 \times f$, when cast-iron.

Thickness of liner cylinder false face ports $= 0.6 \times f$, when steel or bronze.

Whitham gives the following from different authorities:

Van Buren $\begin{cases} t = 0\ 0001\, d\, p + 0.15\sqrt{d} & (5) \\ t = 0\ 03\sqrt{d\, p}. & (6) \end{cases}$

Tredgold, $t = \dfrac{(d + 2\ 5)\, p}{1{,}900}$. (7)

Weisbach, $t = 0.8 + 0.00033\, p\, d$. (8)

Seaton, $t = 0.5 + 0.0004\, p\, d$. (9)

Haswell, $\begin{cases} t = 0\ 0004\, p\, d + \frac{1}{8}\text{(vertical)} & (10) \\ t = 0.0005 p\, d + \frac{1}{8}\text{(horizont'l)} & (11) \end{cases}$

Whitham recommends (6) where provision is made for the re-boring, and where ample strength and rigidity are secured, for horizontal or vertical cylinders of large or small diameter; (9) for large cylinders using steam under 100 pounds gauge pressure, and

$t = 0\ 003\, d\sqrt{p}$ for small cylinders. (12)

Marks gives $t = 0.00028\, p\, d$. (13)

This is a smaller value than is given by the other formulæ quoted; but Marks says that it is not advisable to make a steam cylinder less than 0.75 inch thick under any circumstances.

The following table gives the calculated thickness of cylinders of engines of 10, 30 and 50 inches diameter, assuming p the maximum unbalanced pressure on the piston = 100 pounds per square inch. As the same engines will be used for calculation of other dimensions, other particulars concerning them are here given for reference:

THICKNESS OF CYLINDERS.

Engine No.	1		2	3		4	5		6
Indicated horse-power.. ..I. H. P.	50	..	50	450	....	450	1250	....	1250
Diam. of cyl. in..... ... ...d.	....	10	....	....	30	....	....	50	....
Stroke, feet..... .. L.	1	....	2	2⅔	....	5	4	....	8
Revs. per min.. ....r.	250	..	125	130	....	65	90	....	45
Piston speed, ft. per min.....S	....	500	....	....	650	....	....	700	....
Area of piston, sq. in..... a.	....	78.54	....	....	706.86	....	....	1963.5	....
Mean effective pressure.....M. E. P.	....	42	....	....	32 3	....	....	30	....
Max. total unbalanced pressure..P	.. .	7854	....	....	70,686	..	....	196,350	....
Max. total per sq. in.....p.	....	100.	....	....	100.	....	....	100.	....
THICKNESS OF CYLINDER BY FORMULA.									
(1) .0004 $p\, d + 0\ 5$, short stroke.....	.90	....	...	1.70	....	....	2.50	....	....
(1) .0005 $p\, d + 0.5$, long stroke.....	...	....	1.00	.. .	....	2.00	....	....	3.00
(2) .00033 $p\, d$.....	....	.33	..	....	.99	....	....	1.67	....
(3) .0002 $p\, d + 0.6$.....	....	.80	....	....	1.40	. ..	....	1 60	....
(5) .0001 $p\, d + .15\ \sqrt{d}$.....	....	.57	....	....	1.12	...	....	1.56	....
(6) .03 $\sqrt{d\, p}$	....	.95	...	...	1.64	....	....	2 12	....
(7) $\dfrac{(d + 2.5)}{1.900}\ p$	....	.66	...	....	1.71	....	....	2 76	....
(8) .00033 $p\, d + 0.8$.....	....	1.13	....	....	1 79	....	....	2.45	...
(9) .0004 $p\, d + 0.5$	....	.90	....	....	1.70	....	....	2 50	....
(10) .0004 $p\, d + \frac{1}{8}$ (vertical).....	....	.53	....	....	1.33	....	....	2.13	....
(11) .0005 $p\, d + \frac{1}{8}$ (horizontal).....	...	.63	...	....	1.63	....	....	2 63	.
(12) .003 $d\ \sqrt{p}$ (small engines).	....	30(?)	....	....	....	....	....	....	....
(13) .00028 $d\, p$	....	.28(?)	....	...	.84(?)	.. ..	....	1.40.?)	....
Average of first 11.....		.76			1.48			2.26	

The average corresponds nearly to the formula $t = .00037\, d\, p + 0\ 4$ inch. A convenient approximation to this formula is $t = .0004\, d\, p + 0\ 3$ inch, which gives for

Diameters	10	20	30	40	50	60 inches.
Thicknesses ...	.70	1.10	1.50	1.90	2.30	2.70 inches.

The last formula corresponds to a tensile strength of cast-iron of 12,500 pounds per square inch, with a factor of safety of 10 and an allowance of 0.3 inch for re-boring.

Cylinder Heads.—Thurston, "Manual of the Steam Engine," Part II., p. 75, says:

Cylinder heads may be given a thickness, at the edges and in the flanges, exceeding somewhat that of the cylinder. An excess of not less than 25 per cent. is usual. It may be thinner in the middle. Where made, as is usual in large engines, of two disks with intermediate radiating, connecting ribs or webs, that section which is safe against shearing is probably ample. A shearing stress equal to that taken as safe in tension, in computing thickness of cylinder, is allowable.

An examination of the designs of experienced builders, by Professor Thurston, gave,

$$t'' = \frac{d\, p}{3{,}000} + \tfrac{1}{4} \text{ inch.} \qquad (1)$$

d being the diameter of that circle in which the thickness is taken.

Another formula given by Thurston is,

$$t = .005\, d\, \sqrt{p_1} + 0.25 \qquad (2)$$

Marks', "Proportions of the Steam Engine," p. 19, quoting from Weisbach, gives, $t = 0\ 003\, d\, \sqrt{p}$ (3). He also says a good, practical rule for pressures under 100 pounds per square inch, is to make the thickness of the cylinder heads 1¼ times that of the walls, and applying this factor to his formula for thickness of walls, or .00028 $p\, d$, we have, $t = .00035\, p\, d$ (4).

Whitham, "Steam Engine Design," p. 26, quotes from Seaton, $t = \dfrac{p\, d + 500}{2{,}000}$, which is equal to $.0005\, p\, d + .25$ inch (5) Seaton's formula for cylinder bottoms, quoted above, is $t = 1.1\, f$, in which $f = .0002\ p\ d + .85$ inch, or $t = .00022\, p\, d + .93$. (6). Applying the above formula to the engines of 10, 30 and 50 inches diameter, with maximum unbalanced steam pressure of 100 pounds per square inch, we have,

Cylinder diameter, inches =	10	30	50
(1) $t = .00033\, d\, p + .25$ =	.58	1.25	1.82
(2) $t = .005\, d\ \sqrt{p} + .25$ =	.75	1 75	2.75
(3) $t = .003\, d\ \sqrt{p}$ =	.30	.90	1 50
(4) $t = .00035\, d\, p$ =	.35	1.05	1.75
(5) $t = .0005\, d\, p + .25$ =	.75	1.75	2.75
(6) $t = .00022\, d\, p + .93$ =	1 15	1.59	2.03
Average of 6 .... =	.65	1 38	2.10

The average is expressed by the formula, $t = .00036\ d\ p\ +\ .31$ inch. If we assume that the cylinder head may be broken by direct shearing out of a circle whose diameter is that of the bore of the cylinder, being prevented from breaking at the bolt circle by the increased thickness of the flange, then if S = shearing strength of the metal, and f the factor of safety, $S\, t\, \pi\, d = f\, p\, d^2\, \dfrac{\pi}{4}$, whence $t = \dfrac{f\, p\, d}{4\, S}$. If S be taken at 15,000 pounds per square inch, and $f = 20$, this gives $t = .00033\ d\ p$, which would give for the three cylinders 10, 30 and 50 inches diameter, a thickness, respectively, of .33, 1.00 and 1.67 inches. A factor of safety of 20 is none too great for this case, for the heads of cylinders are exposed to violent shocks.

Web stiffened Cylinder Covers.—Seaton objects to webs for stiffening cast-iron cylinder covers, as a source of danger. The strain on the web is one of tension, and if there should be a nick or defect in the outer edge of the web, the sudden application of strain is apt to start a crack. He recommends that high-pressure cylinders over 24 inches, and low-pressure cylinders over 40 inches diameter, should have their covers cass hollow, with two thicknesses of metal. The depth of the cover at the middle should be about one-quarter the diameter of the piston for pressures of 80 pounds and upwards, and that of the low-pressure cylinder cover of a compound engine equal to that of the high-pressure cylinder. Another rule is to make the depth at the middle not less than 1.3 times the diameter of the piston rod. In the British Navy the cylinder covers are made of steel castings, ⅝ to 1¼ inches thick, generally cast without webs, stiffness being obtained by their form which is often a series of corrugations.

Cylinder Head Bolts.—Diameter of bolt circle for cylinder head = diameter of cylinder + 2 × thickness of cylinder + 2 × diameter of bolts. The bolts should not be more than 6 inches apart (Whitham).

Marks gives for number of bolts, $b = \dfrac{.7854\ d^2\ p}{5{,}000\ c} = .0001571\ \dfrac{d^2\ p}{c}$, in which c = area of a single bolt, p = boiler pressure in pounds per square inch; 5,000 pounds is taken as the safe strain per square inch on the nominal area of the bolt.

Seaton says: Cylinder cover studs and bolts, when made of steel, should be of such a size that the strain in them does not exceed 5,000 pounds per square inch. When of less than ⅞ inch diameter it should not exceed 4,500 pounds per square inch. When of iron the strain should be 20 per cent. less.

Thurston says: Cylinder flanges are made a little thicker than the cylinder, and usually of equal thickness with the flanges of the heads. Cylinder bolts should be so closely spaced as not to allow springing of the flanges and leakage, say, four to five times the thickness of the flanges. Their diameter should be proportioned for a maximum stress of not over 4,000 to 5,000 pounds per square inch.

If d = diameter of cylinder, p = maximum steam pressure, b = number of bolts, s = size or diameter of each bolt, and 5,000 pounds be allowed per square inch of nominal area of the bolt, $.7854\ d^2\ p = 3927\ b\ s^2$; whence $b\ s^2 = .0002\ d^2\ p$; $b = .0002\ \dfrac{d^2\ p}{s^2}$; $s = .01414\ d\ \sqrt{\dfrac{p}{b}}$. For the three engines in our example, we have:

Diameter of cylinder, inches.....	10	30	50
Diameter of bolt circle, approx..	13	35	57.5
Circumference of circle, approx..	40.8	110.	180
Minimum No. of bolts, circ. ÷ 6. .	7	18	30
Diam. of bolts, $s = .01414\ d\ \sqrt{\frac{p}{b}}$	¾ in.	1.00	1 29

The diameter of bolt for the 10 inch cylinder is 0 54 inch by the formula, but ¾ inch is as small as should be taken, on account of possible overstrain by the wrench in screwing up the nut.

The Piston. Details of Construction of Ordinary Pistons.—The following rules are given by Seaton:

Let d be the diameter of the piston in inches, p the effective pressure per square inch on it, x a constant multiplier, found as follows:

$$x = \frac{d}{50} \times \sqrt{p} + 1.$$

The thickness of front of piston near the boss $= 0\ 2 \times x$.

The thickness of front of piston near the rim $= 0\ 17 \times x$.

The thickness of back of piston $= 0.18 \times x$.

The thickness of boss around the rod $= 0.3 \times x$.

The thickness of flange inside packing ring $= 0.23 \times x$.

The thickness of flange at edge $= 0\ 25 \times x$.

The thickness of packing ring $= 0.15 \times x$.

The thickness of junk ring at edge $= 0\ 23 \times x$.

The thickness of junk-ring inside packing ring $= 0\ 21 \times x$.

The thickness of junk ring at bolt holes $= 0\ 35 \times x$.

The thickness of metal around piston edge $= 0\ 25 \times x$.

The breadth of packing ring $= 0\ 63 \times x$.

The depth of piston at center $= 1.4 \times x$.

The lap of junk ring on the piston $= 0.45 \times x$.

The space between piston body and packing ring $= 0.3 \times x$.

The diameter of junk-ring bolts $= 0.1 \times x + 0.25$ in.

The pitch of junk-ring bolts = 10 diameters.

The number of webs in the piston = $\dfrac{d + 20}{12}$.

The thickness of webs in the piston = $0.18 \times x$.

Marks gives the approximate rule, thickness of piston head = $\sqrt[4]{l\, d}$, in which l = length of stroke, and d = diameter of cylinder in inches. Whitham says, in a horizontal engine the rings support the piston, or, at least, a part of it, under ordinary conditions. The pressure due to the weight of the piston upon an area equal to 0.7 the diameter of the cylinder × breadth of ring face should never exceed 200 pounds per square inch. He also gives as a formula much used in this country, breadth of ring face = 0.15 × diameter of cylinder.

For our engines, we have, diameter..... .. .. =	10	30	50
Thickness of piston head			
Marks, $\sqrt[4]{l\, d}$, long stroke.... ..	3 31	5.48	7 60
Marks, short stroke.....	3.94	6.51	8.32
Seaton, depth at center, $= 1.4\left(\frac{d}{50}\sqrt{p} + 1\right)$.....	4.30	9.80	15.40
Seaton, breadth of ring $= .63\left(\frac{d}{50}\sqrt{p} + 1\right)$.	1.89	4.41	6 93
Whitham, breadth of ring $= .15\, d$.....	1.50	4 50	7.50

Fit of Piston Rod into Piston—(Seaton). The most convenient and, at the same time, reliable practice is to turn the piston rod end with a shoulder of $\frac{1}{16}$ inch for small engines, and ⅛ inch for large ones, make the taper 3 inches to the foot until the section of the rod is three-fourths of that of the body, then turn the remaining part parallel; the rod should then fit into the piston so as to leave ⅛ inch between it and the shoulder for large pistons, and $\frac{1}{16}$ inch when small. The shoulder prevents the rod from splitting the piston, and allows of the rod being turned true after long wear without encroaching on the taper.

The piston is secured to the rod by a nut, and the size of the rod should be such that the strain on the section at the bottom of the thread does not exceed 5,500 pounds per square inch for iron, 7,000 pounds for steel. The depth of this nut need not exceed the diameter which would be found by allowing these strains. The nut should be locked to prevent its working loose.

The Railway Ammonia Motor Company has recently had built at the works of the De La Vergne Refrigerating Machine Company, in New York, a motor car upon its system, and a trial took place at the De La Vergne works recently. The car is about the size of an ordinary horse or trolley car, and about one-half of its space is occupied by the motor. Anhydrous ammonia in this car is charged in a reservoir, which is surrounded by a tank filled with hot water. From the reservoir it passes into the cylinder, where it acts on the piston precisely as steam does. The exhaust from the cylinder is conveyed into the water tank, where the ammonia is condensed and can afterward be recovered, the inventors claim, with very small loss. In the trial the reservoir was charged until the pressure was about 150 pounds, and the car was run about a mile backward and forward before the pressure ran down to 100 pounds.

Gaslight in Paris is said to be quite a different thing from gaslight in New York, and quite elaborate articles have been written to show that the trouble is all in the fixtures employed in New York. We feel rather certain that the Paris light from gas is far superior to that in New York, but believe the trouble in the last named city is in the gas, and not in the fixtures.

There is the rather uncommon occurrence in Brooklyn of a railway company being restrained by injunction from selling tickets to Coney Island for ten cents, or for any sum less than fifteen cents. Probably this is all right for somebody, but how about the fellow who pays the fare?

On the Cultivation of the Inventive Capacity by the Solution of Constructive Problems.

BY LEICESTER ALLEN.

In the issue of April 5th, I hazarded an opinion with reference to the solution to Problem No. 5, sent in by Mr. Albert Kingsbury, of the Department of Mechanic Arts, New Hampshire College of Agriculture and the Mechanic Arts, Durham, N. H. This movement is worthy of more attention than at the time it was published it appeared to me to merit. I presume I should never have given it much more thought if Mr. Kingsbury had not addressed me a letter and kindly sent me by express a working model of the device, for which courtesy I take the present opportunity of expressing my thanks. It will be remembered that I said there appeared to me to be, in one position of the movement, the possibility of a dead point: The working model sent to me proved that I was wrong in this surmise, and I have since subjected the movement to a more careful scrutiny. I am now prepared to say that it is not only a beautiful mechanical movement, but that the analysis of the motion, as well as the action of the model, proves that there can be no dead point. This adds another proof to the truism that "things are not always what they seem." In the operation of the model, I was not only much pleased to find there was no dead point, but surprised at the ease and smoothness with which the suspected points in the movement are passed. I strongly recommend those who were influenced in any manner by my remarks to reconsider this problem, as there is in it an extremely interesting subject of study. Mr. Kingsbury writes:

"There is no dead point in the motion as you suggested; and though the theoretical demonstration of that fact is very simple, I send the model to save your time and attention. The 'dead point' would seem, at first sight, to be very obvious—and it seemed so to me at first as well as to you. The solution of the matter is that (aside from friction) the turning movement set up in one disk can only be opposed by an equal and opposite moment in the other. It is little to be wondered at that you should have overlooked this point among the very many you have had to consider, and which must have caused you no small amount of labor."

I confess to having overlooked this theoretical point, and I am much obliged to Mr. Kingsbury for setting me right.

With reference also to Problem No. 5, it appears that I rejected a solution offered by Mr. Charles S. Beach, of Bennington, Vt., as inoperative. Having mislaid the original drawing sent by Mr. Beach, I can only check my judgment by reference to another drawing which he has kindly sent me. I am in doubt that the first drawing shows the parts of the device as does the second, and, so far as I can remember, there was in the first some incongruity that does not appear in the latter, which I have shown in the accompanying Fig. 1. However, I am very willing to admit that I might have possibly been mistaken, and as I wish to do no one the slightest injustice, I have thought it best to describe Mr. Beach's device, although the discussion of Problem No. 5 has been formally closed.

A is the driver and *B* the driven disk. *C* and *D* are bell cranks respectively journaled at *E* and *F*. A connecting rod *G* couples the crank-pins of the two disks, and a link *H* connects the lower extremities of the bell cranks, while the upper arms of the bell cranks are respectively connected to the crank-pins by the links *K* and *L*. In the position shown, the motion of the several parts would be as indicated by the arrows, and there can be no dead point. This is a complete and mechanical construction which perfectly fulfills the conditions of the problem. It is so obviously operative that I cannot think I could have pronounced it otherwise except that the first drawing sent contained elements not shown in the figure, or that I mistook some inoperative device of another contributor for that of Mr. Beach.

I here take the opportunity to say that the labor of preparing these solutions for the press is, as Mr. Kingsbury intimates, not small, and that it has been somewhat increased by the fact that contributors of solutions have, in many cases, not placed their names and addresses on their drawings as well as upon the written descriptions of their devices. I will take it as a favor if those sending in solutions will exercise a little more care in this regard.

Still, deferring the consideration of Problem No. 6, for which I am not yet quite ready, I will proceed to the consideration of solutions of Problem No. 7, which have been offered in addition to those presented in issue of June 28th.

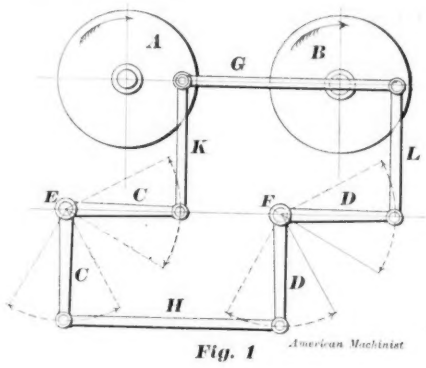


Fig. 1

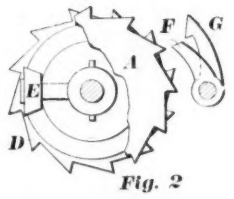


Fig. 2

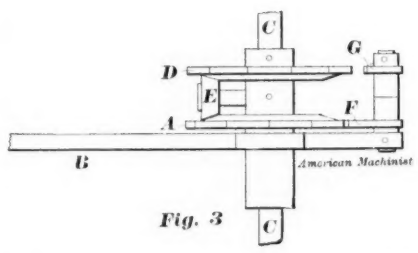


Fig. 3

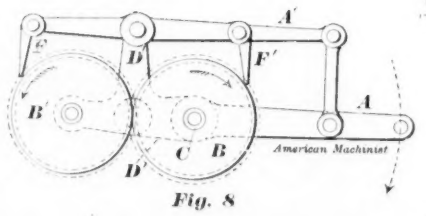


Fig. 8

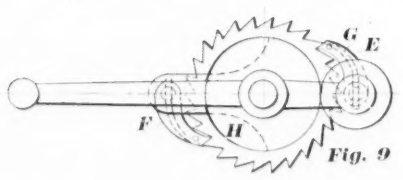


Fig. 9

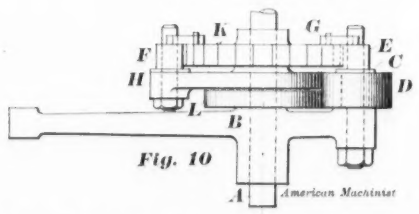


Fig. 10

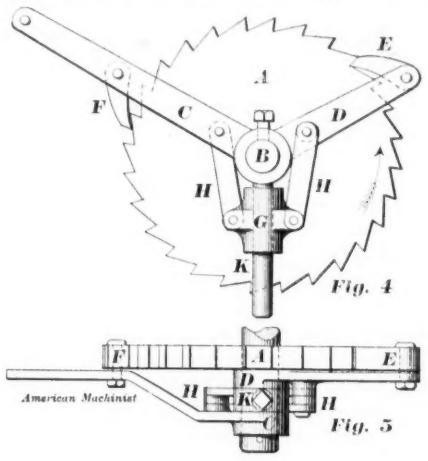


Fig. 4

Fig. 5

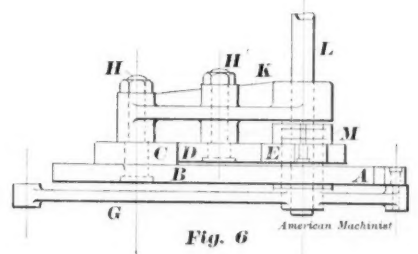


Fig. 6

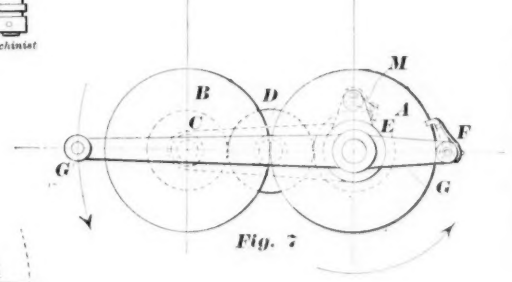


Fig. 7

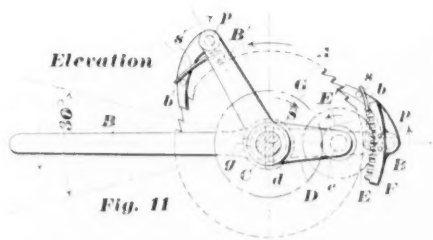


Fig. 11

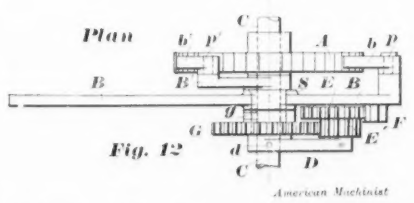


Fig. 12

In Figs. 2 and 3 is shown a solution contributed by Mr. Walter Gribben, of Brooklyn, N. Y. Mr. Gribben's description follows:

"I submit herewith a solution to the problem you present in the May 31 issue of the AMERICAN MACHINIST. I do not know whether to call this an original solution or not, as I may possibly have seen a similar movement on a ratchet drill. Fig. 2 is an elevation, partly in section, and Fig. 3 is a plan view of the device. *A* is the given ratchet wheel, to which I have added a bevel gear on one side. *D* is a combined ratchet and bevel gear, similar to *A* in every respect, except that it is placed on the shaft in a reversed position, so the ratchet teeth point in the opposite direction. Both these ratchets revolve loosely on the given shaft *C* and are connected together by the intermediate gear *E* running loose on a stud fixed tight to the shaft. The given lever *B* has a stud in one end long enough to carry the two pawls *F* and *G* (lifted up to more clearly show the construction), the former a push pawl actuating *A*, and the latter a pull pawl actuating *D*. I drew the ratchets with coarse teeth to show clearly, but, of course, they could be made much finer."

In Figs. 4 and 5 is shown a neat solution contributed by Mr. W. C. Davis, of Denver, Colorado, manager of the F. M. Davis Iron Works Co. The ratchet wheel *A*, turns on the stationary pin *B*. To the pin *B* is also secured the guide *K*. Two levers *C* and *D* are also mounted on the pin *B*, so that they turn freely. On the guide *K* is the slide *G* connected to the levers *C* and *D* by the connections *H H*. By moving the lever *C* down, the slide *G* is moved down, drawing the lever *D* in the same direction; and, by the pawl *F* turning the ratchet wheel in the direction of the arrow. When the lever *C* is raised, the lever *D* is also raised, and the pawl *E* turns the ratchet wheel in the direction of the arrow. This construction is good and mechanical, and would answer well for any light work. For heavy work the lower extremity of the guide *K* could be supported to relieve the pin *B* from excessive torsion.

Mr. H. W. Lloyd, of New York City, has solved the problem substantially in the same way as did Mr. H. D. Peney, whose solution was shown in Fig. 3 in my last article, issue of June 28th.

In Figs. 6 and 7 is shown another way of reaching the desired result. This solution is contributed by Mr. Edmund Bury, of Erie, Pa. The ratchet or gear wheel, which must rotate in one direction by the to and fro movement of the oscillating lever, is shown at *a*. The lever is shown at *G*. The wheel *a* is journaled on the hub of the lever. When the lever is rotated in the direction indicated by the arrow in Fig. 7, the pawl *F* engages and rotates the ratchet wheel in the direction indicated. This ratchet wheel is also a gear wheel, the teeth being cut in the form customary in gears instead of having the serrate form usual with ordinary ratchets. The teeth of *a* intermesh with those of a similar wheel *B*, which rotates on the stud *H*, carried by an arm *K*, which is keyed to the spindle *L*, as shown in Fig. 6. To the wheel *B* is keyed a pinion *C* so that these parts rotate together and through the same arc. A similar pinion *E* plays freely on the hub of the wheel *a*. An idler wheel *D*, carried on a stud *H'*, meshes with both the pinions *C* and *E*. The wheels *a* and *B* have the same number of teeth, and the operation is as follows: The hub of the lever extends through the wheel *a* and the pinion *E*, and also supports between the latter and the arm *K*, an arm which carries the pawl *M*, which arm is keyed to the hub of the lever. The operation is as follows, referring to Fig. 7: When the arm *G* is pressed downward, as indicated by the arrow, the wheel *a* is caused to rotate as indicated by the adjacent arrow. This causes *B* and *C* to rotate in the opposite direction, and, through the idler *D* to rotate the pinion *E* in a direction opposite to that of *a*. At the same time the arm *M*, which is keyed to the hub of the lever, moves in the same direction as that of the wheel *a*, and consequently the pawl *M* passes over twice the number of degrees of arc measured on the pinion *E*, as is contained in the arc described by the wheel *a* during this part of the movement. When the motion of *G* is reversed the pawl *M* engages the teeth of *E*, causing it to continue its motion in the same direction as before, and this motion acts, through *D*, *C* and *B*, to turn *a* in the same direction as in the first part of the movement. The two pinions have each the same number of teeth, and their pitch lines have each half the diameter of that of the pitch circles of the wheels; consequently the arc described during the upward movement of the lever *G* will be the same as that described during the downward movement, the lever being supposed to move through the same arc during each of these movements.

The movement described is a good mechanical construction. Of course, it is not necessary, except to fulfill the conditions of the problem as announced, that the arm *K* carrying the studs should be supported wholly or in part by the spindle *L*. Mr. Bury concludes his letter describing the device as follows:

"I have shown the pawls engaging directly with the teeth of wheels, but this may be modified by placing a fine ratchet on the rims of the wheels so as to cause less lost motion before the pawls engage. Flat springs are also shown to keep the pawls in engagement. I would say that this is my first attempt at solving any of these problems, but my interest in them has not been the less, for I am sure they and their solutions form a valuable addition to any mechanic's library."

In Fig. 8 is shown a solution contributed by Mr. James Tobin, of New York, which effects the movement by a very simple mechanism. Assuming *B* to be the wheel desired to be turned in the same direction by each movement of the lever *A*, and *C* its spindle, let *D*, in dotted outline, represent a supporting arm having at its outer extremity a bearing for the wheel *B*, and rising from the middle of this arm, an upright *D'* having at its upper end a journal for the lever *A'*. At equal distances from this journal, and on opposite sides of it are pivoted to the lever the pawls *F F'*. The two wheels are of the same pitch diameter, and each has the same number of teeth. The pawls engage the wheels, respectively,

as shown in the figure. When A is moved in the direction shown by the arrow, B is moved in the direction shown by the arrow on the wheel, and the wheel B' is moved in the direction opposite to that of B. The pawl F is at the same time caused to pass over twice the number of teeth which measure the distance through which B is rotated during the descent of A. When A is moved upward the end of A carrying the pawl F is depressed, describing the same arc, and the pawl engaging the teeth of B' causes it to move B also through the same arc and in the same direction it moves during the downward stroke of the lever.

Figs. 9 and 10 illustrate a solution contributed by Mr. Herman Oberg, of Utica, N. Y. In the figures A is the fixed shaft, and B the rock lever, to the short arm of which a pin C is fastened parallel to A. On this pin are placed the freely turning gear D and the pawl E with its spring G. The latter is fitted in a rectangular hole in the end of the pin C, this hole being located so as to prevent the pawl from moving laterally. H is rock lever that turns on the shaft A. One of the lever arms has a pawl F similar to E, while the opposite one forms a segmental gear in mesh with the gear D. The gear L is keyed to the shaft A, and is also in mesh with D. If the longer arm of B be moved downward, the pawl E will turn the ratchet wheel K, and at the same time the fixed gear L causes the gear D to revolve in the same direction, D driving the rock lever H in the opposite direction, and letting the pawl F go idle. On the upward stroke of B the motion of the rocker H will, of course, be reversed so that the pawl F will work while E goes idle.

I will conclude this article with a solution presented by Mr. H. W. Lloyd, of New York City, Figs. 11 and 12:

"In this mechanism let A be a ratchet wheel loosely mounted on a fixed spindle C and actuated by a pawl b pivoted at P on the short arm of the lever B, which turns freely on the fixed spindle C. It is evident that if the lever B is moved in the direction of the arrow, the pawl b will drive the ratchet wheel A through any desired arc.

"It is required to add such mechanism to the above that the wheel A shall move through the same arc during the upward movement of the lever B as it now does during the downward movement. The condition is that all added mechanism shall be carried either by the spindle C or the lever B.

"Pinned to the spindle C is the arm D, having at its outer end a stud e on which are mounted the gear E and the pinion E'. Loosely mounted on the spindle C, and passing loosely through the hub of the lever B is a sleeve S, having at one end the arm B', and secured to it at the other end the gear G, meshing with the pinion E'. The arm B' carries a pawl b' pivoted at p'. The pawls b and b' are held in mesh with the ratchet wheel A by springs s and s' respectively, shown in elevation, but not in plan.

"The proportions of the gears are as follows:

Radius $E = \frac{1}{3}$ radius F.

Radius $E' = \frac{1}{3}$ radius G.

"It follows from this that if the lever B, and with it the gear F is turned, say, through an angle of 30°, then the gear E and pinion E' will turn through an angle of 30° in an opposite direction to that of the gear F. Therefore, while the pawl b is driving the ratchet A the pawl b' is being drawn back, but b' will begin to drive when the lever B is reversed. Thus, the wheel A will always turn in the same direction, and will move through the same arc when the lever B is moving up as when it is moving down."

In this solution Mr. Lloyd has worked out an excellent mechanical movement.

I have still in hand, besides solutions to Problem No. 6, quite a number of solutions to Problem No. 7, which will be noticed, all in due time.

The statement is made that no large advertiser has failed during these hard times.

Instrument for Drawing Hyperbolas and Ellipses.

BY PROF. FREDERIC R. HONEY.

In your Questions and Answers column June 14th you explain the construction of the hyperbola.

Your correspondent and others may be interested to read a description of an instrument which I have devised for drawing hyperbolas and ellipses.

A, Fig. 1, is a T-square. Mounted on the stock is a clock barrel B, around which is wound a double line, the two ends of which are fastened to it.

The saddles a and b are adjustable, and may be set at any desired distance apart, being fastened to the blade of the square by the set screws s s. These saddles carry small eyes c and d, through which the line passes, both parts passing through c. Fig. 2 shows the position of the line when the instrument is not in use, the spring causing the barrel to revolve in the direction of the arrow keeps it taut. Fig. 2 is very much exaggerated, in order that the reader may see clearly how the line is threaded through the eyes.

Referring to Fig. 1, if we take hold of the line at any point p and pull it, the barrel will revolve in a direction contrary to that indicated by the arrow, and the part of the line r will pay out round the eye c, while the part r' will pay out round the eye d, and since these two parts come off the barrel together, their lengths increase at the same rate, *i. e.*, the difference between their lengths is constant; therefore the point p traces the hyperbola $e\ p\ f$. To prevent the pencil from slipping on the line a turn should be made round it. For accurate work the line may be of surgeon's silk. For black-board purposes a gut line may be employed. The other branch of the hyperbola $e'\ p'\ f'$ is described by taking hold of the line at a point p' at a distance from c equal to that which was measured from d. The broken lines $c\ p'\ p'\ d$ show the position of the line when the other branch of the curve is drawn.

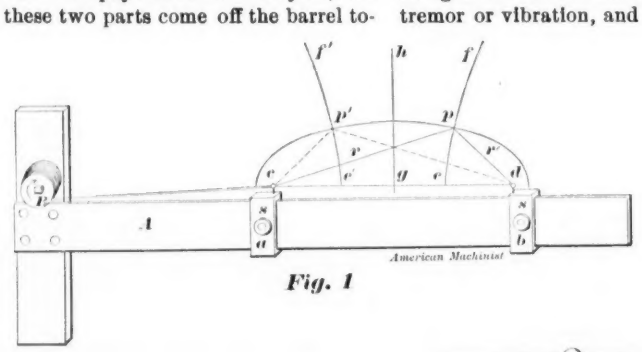


Fig. 1

Fig. 2

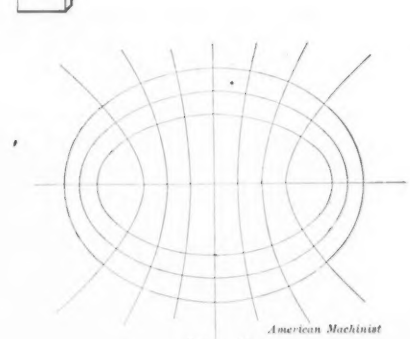


Fig. 3

A point midway between c and d will describe a straight line $g\ h$ the conjugate axis of the hyperbola. If the barrel be prevented from revolving when the line is extended to any point, and the pencil be allowed to slide on it, it will describe an ellipse according to the well-known method, and the ellipse will intersect the hyperbola perpendicular to it at p and p'.

If the instrument be reversed the remaining half of each curve may be described as in Fig. 3, which illustrates confocal* ellipses and hyperbolas drawn with this instrument, all the ellipses being normal to all the hyperbolas at the points of intersection.

One of those terrible accidents, the possibility of which is always present to those who mine the coal that keeps others comfortable, and ministers to their wants otherwise, occurred recently in Stockton Colliery. Some giant powder which had been sent down for the use of the miners exploded, literally tearing eight of them in pieces.

* See Prof. Newcomb's Elements of Geometry, page 263. Art. 542 seq. Also Theorem X.

The Fastest Ship in the World.

On Saturday last the record of speed was broken for any torpedo vessel—or, in fact, for any steamer in the world—in the time of the torpedo catcher, H. M. S. "Daring," the mean of three runs over the Admiralty measured mile on the Maplin Sands reaching the unprecedented speed of 28.6 knots, and the last of the three runs occupying only 2 minutes 3 seconds, equivalent to a speed of 29.3 knots. Those privileged to receive an invitation to the trip, which included Sir Frederick Bramwell, Mr. Crookes, Mr. Arnold Foster, M. P., and Mr. C. V. Boys, were instructed to assemble at the Temple Pier at 9.30, where they were met by Messrs. Thornycroft and Donaldson, and by Mr. S. W. Barnaby.

The "Daring" is seen at moorings in the stream, and shortly before ten comes alongside the pier, and a start is made down the river on a favorable ebb tide. Without the slightest apparent effort on the part of the engines, we slip past everything on the river at a speed as great as is permitted, but after Woolwich is past we are allowed to extend ourselves, and we glide along at about 15 knots without the smallest tremor or vibration, and with extraordinarily little bow or stern wave displacement; insomuch that the trial run is not such an object lesson in the production of waves as was to be anticipated.

Down below in the ward room at luncheon the motion is so quiet, that Sir Frederick Bramwell, in proposing the health of the builders, surmises that the speed must be about eight knots, and Mr. Donaldson, in responding for the firm, undertakes to add another twenty to that figure before we return home. On arrival at the measured mile off Shoeburyness a series of progressive trials are begun, starting at about 100 revolutions a minute, with the object of speeding the screw propellers and determining their slip, while the turning required at the end of each mile is a valuable test of the rudder power, and of the radius at which the turning can be effected at various speeds.

Each time the revolutions and speed are gradually increased, until at last we prepare for the final effort. Flames now begin to be seen, even in the daylight, occasionally streaming from the chimneys, and the safety-valves blow off. Against the wind the rush of air is like that past an express train and shelter must be sought; but the visitors are allowed to choose their own stations, and there does not appear to be any anxiety on the score of disturbing the trim, as would be the case on a sailing yacht, or on a submarine boat, where one man has to walk aft when another wants to go forward. At full speed a curious sensation is felt that we have taken leave of gravity, and the oscillations are as light and gentle as if all stability was nearly gone.

The times are taken independently by some half-dozen stop watches to the tenth of a second, and little discrepancies are noted, as they are in the hands of practiced observers. One skillful experimenter is rallied for keeping both eyes open in observing the fixed marks, but he turns the tables by saying that he holds his two eyes in a vertical line. Considering that the tenth of a second now influences the figures in the second place of decimals in the record of the speed, it looks as if the delicate instruments employed for registering the flight of artillery projectiles will soon be required.

A gunboat, H. M. S. "Bullfrog," is coming leisurely down the mile while the three last runs are made, and the mean speed of 28.6 knots is chalked on a board, and held up for the information of the officer on the bridge. At full speed on the last three runs the freedom from vibration is very remarkable, thanks to the Thornycroft system of engine, in which the cylinders, arranged in pairs, actuate cranks set at 180 degrees, so that the inertia stresses are self contained. Each engine has two such pairs, making eight cylinders in all on board. During the run some eight young pupils or apprentices are seated each very nearly on the top of a cylinder, taking the indicator cards; below them are more attendants and the chief engineer, standing in a torrent of movement and spray, on the anxious watch for a hot bearing, no trace of which, however, marred their peace of mind. But the real mainspring of the action is in the stokeholds, which are closed and supplied with air by powerful fans to a strong pressure as measured in inches of water.

The Thornycroft engines perform their work visibly to perfection, but after all it is the Thornycroft boilers which keep them going at some 4,800 horse-power, and abundantly supplied them with steam at about 250 pounds on the square inch, as far as can be judged from the needle of the gauge, which is in a state of agitation with the varying velocity in the steam pipe. These boilers are three in number, of the Thornycroft improved water-tube type, and are capable of raising steam from cold water in fifteen minutes; in fact, we start with one boiler, and the other two are not set going till some way down the river. An automatic system of feed has been adopted, by means of float gear of the nature of a ball-cock in the interior, which must save a deal of anxiety among the stokers, whose whole energies are required elsewhere during the full-speed runs. The old-fashioned system of communication with below, by blows with a handspike on the hatch, as described in "Two Years Before the Mast," was to be seen in use, to warn the stokehold complement of the beginning and end of a run; the run finished, the hatch would be seen to lift slightly by some influence below, so as to regain touch and enthusiasm by contact with the world above.

Together with the freedom from vibration, the absence of any great bow wave or wake disturbance is very remarkable; the wake shows the spinning effect of the propeller very clearly, but there is no upheaval of the water to notice, and, to all appearance, the wake is as flat at full speed as at an ordinary 15 knots. This smoothness of wake and the absence of squatting must be attributed to the Thornycroft form of stern, which above the water-line is of full midship breadth, and forms a chamber drawing a few inches of water; this chamber is utilized for the steam steering gear and the captain's cabin. The propellers are thus covered in, and can work close to the surface of the water without splashing, while squatting is minimized by the large water-line area astern, which calls into play an extra buoyancy for slight changes of trim.

The trials finished, Mr. Barnaby plots the results diagrammatically alongside his predicted calculated results, with very close agreement. The spots, showing the slip at the various revolutions and speeds, range

themselves very nearly in a straight line, and even a slight diminution of slip is perceptible at the highest speeds. This is attributed to the employment of ample blade area in the propellers, which otherwise would tear the water, and the slip would be unduly increased when the speed exceeded a certain amount. The return voyage is made as rapidly as the run down, and the company of visitors disembark at the Temple Pier at about seven o'clock, with the proud sensation of having assisted in the most notable experiment in speed at sea that the world has yet witnessed.

The "Daring" is the first of the five torpedo boat Destroyers in course of construction by Messrs. J. I. Thornycroft & Co., to form part of the new Destroyer flotilla, which is the latest departure in the Admiralty naval policy. The dimensions are:—Length 185 feet, beam 19 feet, draught 7 feet. The vessels have been designed for the purpose of overtaking torpedo boats and destroying them by shell fire, and for this purpose a considerably higher speed than that of the first class torpedo boat is required, so that the guaranteed speed is 27 knots, to be obtained for a continuous three-hours' run at sea.

They will be armed with six quick firing guns of different calibers, and provision is made for fitting them as torpedo vessels if required. The larger size of the Destroyers, as compared with the torpedo boat, enables them to maintain their speed much better in rough water; and to make it more difficult for a torpedo boat to escape, the Thornycroft boats are fitted with a special system of double rudders, which give them exceptional maneuvering power, and enable them to be steered astern quite as well as ahead. This was tested on the measured mile, so that these greyhounds of the sea can double and turn as fast as the hares they pursue. The actual records of the three last runs at full speed are as follows:

	Time.	Speed.	Revs. per min.
1. Against tide	2 m. 7 6 s.	28.214 knots	383
2. With tide	2 m. 6 s.	28.571 knots	385.7
3. Against tide	2 m. 3 s.	29.268 knots	395.1

The horse power indicated was estimated at 4,800 to 4,900.—*The Engineer* (London).

LETTERS FROM PRACTICAL MEN.

Changing Machine Designs to Suit the Customer.

Editor American Machinist:

A question in which many of us are interested, and regarding which a discussion in these columns would be of benefit, is that of the desirability of changing designs in standard machines. This matter of change presents itself in two aspects: Change for the mere improvement in design or efficiency of machine, and change at the request of a purchaser, to meet his special conditions, or to humor him in some whim and thereby secure his order.

Regarding the first, it must certainly be agreed that any *improvement*, be it for the convenience of the purchaser or to facilitate in the process of manufacture, must be advantageous, but with this important reservation: The improvement must pay from a simple business standpoint. A very slight gain in the efficiency of a machine may, in much larger degree, add to its cost, and would therefore be ill advised, while a bit of simplification brought to light by seeing the machine in operation may, without decreasing either its strength or its capacity for doing a given amount of work, very materially reduce the cost of manufacture.

After all, the entire question of changes in machine design resolves itself into one of pure and simple business, and the advisability of any given action must depend upon its financial return, whether it will pay or not. Will it pay to make a change in the frame of a machine that necessitates the construction of an entirely new pattern? The cost of the pattern may be reasonably estimated, the saving in cost of construction, if any, may be closely calculated in advance, and, in the case of a standard machine, the yearly sales will give a basis upon which to determine the length of time it will take for the improvement to pay for itself. The same holds true with special tools, jigs, templates and the like.

The necessity of certain small changes and improvements in a newly designed machine is almost certain to arise. When its character will permit, it is, of course, of great advantage to first build and operate an experimental machine. Even in the case of designs of long standing experience is constantly presenting some opportunity for improvement. Whether change thereby necessitated shall be made immediately upon the next lot of machines, or shall be deferred until several suggestions have presented themselves, and then a general change be made in the entire machine, is a question of considerable importance to be determined to a great extent by the character of the machine and the number manufactured. The latter plan has the advantage of avoiding mistakes in the process of manufacture, of reducing the resulting differences between machines and thereby facilitating the keeping of records regarding their construction and simplifying the matter of furnishing parts for repairs.

Just how far the manufacturer shall depart from his usual practice and standard designs in order to meet the desires of his customer is a question upon which opinions must differ greatly. The latter certainly has the power to refuse to give his order if his wishes are not complied with, while the manufacturer can maintain the strength of his position by declining to accept the order under the stipulated conditions. But what manufacturer can deliberately put aside such an opportunity. Certainly, it is no easy matter to establish a principle and live up to it under such circumstances.

Of course, these remarks apply only to standard machines carefully designed to perform certain work and shown by experience to be capable of doing it successfully. If a steam engine builder knows his engines to be properly designed and constructed, is he acting justly toward himself if he changes the diameters of his crank-pins and shafts, be it to larger or smaller, simply because purchasers so desire it? Certainly, he is not when he knows that such change will decrease the strength or efficiency of the engine, or will display disproportion in the design. The excuse that the purchaser takes the risk is most short sighted.

The manufacturer who lacks sufficient principle to withstand such suggestions of improper changes will be at once detected by the sagacious purchaser, and such confidence in his ability as a manufacturer, as he may have previously inspired, will be gone forever. On the other hand, the man who, knowing that his lathe is properly designed, and will satisfactorily and continuously turn out a certain size and class of work, deliberately refuses to change it, so as to attempt to do the work of the next size larger machine, shows at once his force of character and his business sagacity. Whatever he may gain by fitting up the first named machine, he will certainly lose in not selling the one that is one size larger and properly proportioned, and in probable adverse criticism on the efficiency of the changed machine.

Apparently slight, special or temporary changes cost far more than at first appears, for they have an influence not only on the direct cost of manufacturing, but also upon the expense of the office in entering the order accurately, the drafting room in changing drawings and keeping records, the shipping department in avoiding mistakes by shipping a regular instead of a special machine, and the furnishing of parts for repairs at some future time. Finally, a loss in future sales may result from failure of the machine due to the changes; for few purchasers will blame themselves for such ill success, but rather the manufacturer who, knowing better, consented to build the special machine.

Salesmen, if not emphatically instructed, often very seriously interfere with adherence to the principle of permanent standard designs, by their deliberate offers to make any desired changes if they can only secure the order. Too frequently the salesman actually, although perhaps unintentionally, favors the customers more than his own employer in such matters. He increases his gross sales, but decreases the net profits.

The exigencies of competitive manufacture introduce a feature in the matter of changes that is seriously considered by many machine builders. It becomes a question whether the business may not be increased by a deliberate and radical change in the entire machine, not because of failure on the part of the machine as originally designed, but simply to present something new. In certain lines this is assuredly undesirable, but in others it is a serious question whether it is not an absolute necessity.

On the one hand, most men incline toward conservatism in the purchase of machinery; a type of tool or machine they have used for years naturally appeals to them as a more desirable purchase than one, no matter what its prophesied merits, that has never been thoroughly tested. But, once improvement is conclusively shown, appreciation of it is certain to be indicated by the purchaser.

On the other hand, the very newness and novelty of a design, rather than its actual efficiency, becomes in many cases its selling feature. New, but not greatly improved designs, if at all desirable from a business standpoint, are most likely to prove so in the case of machines of which only one, or at least but very few, will probably be sold to a single individual. A steam engine, a heating apparatus, electric lights and sprinkler systems, large special tools and the like, would come under this head, and the salesman will frequently materially aid his prospects of a sale by presenting the changes; of course, terming them all improvements, by talking of progress, and indirectly implying the lack of it on the part of his competitors.

Just what practical advantage or disadvantage has resulted in given cases from the change of designs it would certainly be very interesting for the readers of the AMERICAN MACHINIST to learn from those who have been through the experience, and are willing to favor us with it.

WALTER B. SNOW.

Notes on Boilers.

Editor American Machinist:

For determining the height of water in boilers, the water column combining the water glass and gauge cocks has come to stay. Its neatness and beauty as well as its correctness when properly put up and used render it at once a necessity and an ornament. But the rub comes in when I am prone to wish for the old style gauge cocks, each a separate entrance to the boiler. For the ways of the men who pipe up columns are indeed inscrutable and their logic is beyond our knowledge. Who would dream of bushing down 1 inch holes to ⅜ inch, or of using a loop in the water pipe "so she wouldn't wobble her water in the glass." She didn't wobble either, for the loop was solid with lime, though the rear tubes indicated the fact before the attendant did.

The solids play an important part, indeed, with the lower pipe to the water column. Were boilers not bothered with the precipitated solids almost any size pipe would do for our purpose, but, as it is, we study to lay down the best plans that can be formulated. Where more than two boilers are set close together, the lower pipe should not come out of the side of the shell for the reason that from the interior it is very difficult, in some cases impossible, to clean this pipe, and when run direct to the side of the column there is no way (unless a union is put in) to get through from the outer end. Should the pipe require repair, there is the brickwork to remove and replace, to delay what is often a hurry up job.

Then the water pipe to the column should not enter the side of the column for horizontal tubular boilers using feed-water with solids to an annoying extent. Why? Well, we get to pinning our faith on water glasses, and when the entry pipe occurs near the glass fixtures with their small opening, we are taking chances that are not necessary. The scale and slush clog these up, and good men get fooled. Then it is true, also, that piping direct horizontally (as is meant in above) there is more scum, dirt and slush or sludge carried into the column than is necessary.

A pipe lower down extending out, then a vertical riser with a short pipe entering the column, using elbows all around, is a common error. The use of a proper sized blow-off is of little value in this case, as the lower pipe will clog up owing to the laws of gravity and the difference in the velocity of steam and water under equal pressures.

The size of the pipe is an important factor. I would recommend 1¼ inches all around and the use of crosses instead of "Ls" or "Ts." I prefer these of malleable iron, and iron plugs with graphite and cylinder oil, so the fireman will dispense with profanity and not break your best monkey wrench.

I had occasion to do some scheming for this subject recently on a five-boiler plant. Boilers all in one battery, but with fire walls between and arranged so any one or more could be used. Well, I got the builder to cut out in the pattern of the cast-iron side swing breeching doors a piece 4 inches by 6 inches, and add a 6-inch by 7 inch piece to the corresponding part of the front. Through this piece the proper size hole being drilled, a 1¼-inch pipe was run into the boiler head about 12 inches from the bottom, but near the flange of the head. At the outer end a cross was placed, then piped sideways 14 inches, a cross terminating. From this a 1¼ inch riser, a good globe valve and a nipple entered the water column. Below the second cross the pipe dropped 12 inches to a valve, then was piped to the ash pit. I placed the globe valve below the column, so that by closing it and opening the lower valve a direct stream blew through the main pipe to clean it. And it is handy to get at there. The pipe in the breeching being low down and to one side does not "make steam" from the hot gases. It is readily got at for cleaning or repairs. A stop piece prevents the swing door from striking the column, and the door clears the piping. The water column at the glass gets clean water, and the circulation is completed by using the same size pipe to the top of the shell, nothing else save the steam gauge being connected to the upper pipe. The gauge cocks were compression with ¼ inch holes. We melted out the lead, replacing with good babbitt metal. The babbitt makes a long-life seat, while the compression gauges enable Jim to keep his boiler fronts clean. Jim says while he has taken all the degrees incidental to old-fashioned camp meetings, he now claims exemption from being sprinkled every time he tests the gauge cocks, and so will have none of the "Mississippi" or any other style having a tendency to blow slush all over the boiler front and the operator. As I admire neatness here, I am inclined to his opinion, and viewing the plant as referred to, I offer it to your readers and to boiler makers as worthy of duplication.

TOM THRALL.

An Example of the Necessity of Counterbalancing.

Editor American Machinist:

To illustrate the necessity of balancing, allow me to refer to an experience of my own some years since. I designed a semi-automatic drilling machine for a well-known firm in this vicinity in the manufacturing of vegetable ivory buttons. The spindles which carried the drills were ⅝ inch diameter and ran in substantial babbitt lined boxes, nicely bored out to fit spindle at each end, the driving pulley being between the two bearings, each above 2 inches long. At one end of spindle it extended ⅞ of an inch outside of bearing; the drill was small, about 1/16 inch diameter, and fitted into a split bushing ¼ inch diameter, which fitted nicely a hole bored in end of spindle; to hold drill and bush to spindle, a ¼ inch set screw was used, having a square head ¼ inch square and its outer end being only ¼ inch from the

outside diameter of spindle. Of course, without any special test in the matter, I reasoned that the head would give no trouble, being light and so near the spindle. The rate of speed of the spindles was 10,000 revolutions per minute, and so when the machine was completed and set up it ran smooth, and so well was the machine liked that others were built and set up and run likewise. About three months' later the "super" came to me saying that something was the matter with the spindles of the first machine we built. One of the spindles was taken out of machine, and it was found that on the end which had the set-screw, opposite to the screw, that a flattened side was worn the length of the bearing; the box was in quite good condition, while both bearing surfaces of spindle and box of rear end of spindle were in good shape.

That set screw head weighed but slightly above ¼ of an ounce, and yet at 10,000 revolutions per minute in time it gave trouble, because it made the spindle out of balance.

When the machine was new no effect was observed; it ran smoothly until the super weight on one side of spindle wore the spindle bearing at that end "out of round" —then it began to "pound."

FRANCIS W. CLOUGH.

Leaking of Compressed Air.

Editor American Machinist:

Your respected correspondent, "Quirk," in the AMERICAN MACHINIST, July 12th, speaking of compressed air says: "The facility with which it escapes, unemployed, is often a mystery, even to those who give it close attention." A couple of years ago I was compelled to make a flying trip of over a thousand miles and back again just to tell the parties interested in a certain compressed air plant, then just started, that they were leaking away nine tenths of the air compressed. The leaks were found and stopped, which solved all the mystery, and the plant is to day probably the largest and most successful air-hoisting plant in the United States.

At Offenbach, in Germany, there is a compressed air plant in successful operation transmitting 500 horse-power. About 25 000 feet of pipe is employed, the largest being 12 inches diameter. The pressure carried is 70 to 80 pounds. The pipes were allowed to stand with the pressure on for a considerable time, presumably to test the "mystery" about them. The loss of pressure was 1½ pounds in 7½ hours. Honest workmanship pretty effectually dispelled all "mystery" in this case. With air at 80 pounds pressure a $\frac{1}{16}$-inch hole will discharge as much air as it takes one horse power to compress, but if there is no hole there need be no fear that the air will escape.

I did not suppose that my fire engine suggestion would revolutionize the service all at once, but it is probable that if air were tried for a fire engine it would not be long before it would be used for a second and a third, and so on, just as air progresses when applied to any other purpose.

FRANK RICHARDS.

Evaporation Tests.

Editor American Machinist:

Nowadays when a man brings out an improvement of any sort he wants to have it tested and the results published. This is perfectly justifiable as a means of advertising, even when the test is reported in the letter-press columns, so long as it is honestly done, for a carefully reported test has undoubtedly an interest quite outside that intended, and serves as a vehicle of scientific fact in very many cases. But a quite frequently occurring class of men appear to think they can have published any sort of cooked up results as fact, and some will go very far, indeed, and if allowed to have their own way, would simply make themselves and their appliances ridiculous in the eyes of men who know. Evaporation tests seem to be specially liable to exaggeration or distortion. It is not so very long ago that a comparative test was undertaken of a pair of boilers in the interest of the makers of one of them. In the published results one boiler showed a very good evaporation per pound of coal—somewhere between 9 and 10 pounds—a result so good, indeed, that it was, under the circumstances, all that one cared to do to give it credence. The other and interested boiler, however, came off with an evaporation of over 13 pounds per pound of coal. This result was duly attested by the engineer responsible for the test, and published by a journal, which must have known better, without the slightest comment. Now, had I been the maker of this boiler showing over 13 pounds evaporation, I should have written to ask for a re-test, on the ground that I could not afford to have it known that I *could* make a boiler giving such results, for all my other customers would charge me with doing only my second best for them by supplying boilers of only two-thirds the above efficiency.

Another somewhat similar instance occurred very recently. A Cornish boiler was tested, and gave an evaporation of about 4½ pounds—a miserable result. It had then riveted to it outside in the external flue space a series of longitudinal radially projecting ribs after the principle of the Servè ribbed boiler tube, a perfectly sound proceeding, no doubt, and one calculated to give an improved evaporation. A 5 per cent. improvement, if reported, would have looked a good return for the addition. Still, 5 per cent. might have been swallowed—it was not so big a morsel as to warrant any one in setting it down as an extravagant claim, and doubts would have been limited to a guarded expression of surprise that so much had been done. But, what are we told? The additions doubled the evaporative power of the boiler, or very nearly so. I have not the exact figures before me. Now, here comes the point. The improved evaporation is not more than *might* have been gotten with this boiler in its plain, unadorned condition under favorable conditions, and yet it is about double what was said to be obtained prior to the alterations. It would seem that those responsible for the tests think that no one knows what a plain Cornish boiler should evaporate. These tests were also published without comment as to their lack of consistency. This latter case is thus not one of falsifying the higher results, but of unwarrantably reducing the datum line of comparison. No practical man is deceived by these "tests," for he knows how the datum line may have been lowered by a half covered grate. It is very contemptible, all the same, and calculated to advance the reputation neither of the articles tested nor of the men responsible for such tests. Only to-day an instance of a parallel nature was brought to my notice. An engineer was asked to report upon a certain process, the nature of which I need not particularly specify, but which was supposed to be carried on continuously night and day, and this continuity of the process was supposed to be of special importance in weighing results. Now, the waste products from the machines ran to waste into a sewer, in the middle of which was a reservoir that had another secret let-out. Unknown to those responsible for the continuous working of the process, this reservoir was run empty by the secret let-out which was then closed. As this reservoir held only about three hours run of the waste liquid, and was found only partially full after a supposed period of 12 hours continuous work, it is possible that by this simple precaution the engineer has been able to avoid giving an inaccurate and misleading report. He is now wondering to whose interest it was that the output should be made to appear different from the actual capacity of plant. This shows how careful it is necessary to be when reporting upon any matter of which some of the data have to be taken as granted, to state that the investigator has been informed that such and such is the case, and that upon the accuracy of such information the reliability of the conclusions depend. Unless this precaution be taken an engineer may find that he has made himself responsible for more than he ever thought for, and I would have such statements of furnished data made clearly, and not slurred over, as often done, somewhat thus: "Taking the coal consumed, as given, at 5 tons," the words "as given" being the only information afforded that this item is not guaranteed by the testing engineer from his personal knowledge.

The least we can ask is that tests so obviously distorted as I have described should be refused publication.

W. H. BOOTH.

Removing a Crank Disk.

Editor American Machinist:

I once had an experience somewhat related to the one given in the AMERICAN MACHINIST May 31st, and referred to June 28th.

I was in a shop where a heavy balanced crank for gang saw mill was brought to have the shaft taken out. The crank was not a disk, but was something like the sketch inclosed, and weighed 17½ cwt. The shaft was 7 inches diameter and 5 feet long, and, except the part going into the

crank, and a bearing next to it, was square, to be set in a wooden water-wheel shaft, and, as it had to be put into a new one, the crank had to be taken off to get a chance to drive the keys.

Of course, they tried hard to get it out at the mill before they started with a team to go 15 miles to the shop, and the end of the shaft, which reached about ½ inch through the crank, was badly hammered, although they had not got the key out. The men got it into the shop, got the key out, and then went at it with a very heavy sledge, each one taking it in turn as long as he could swing it. One man of elephantine size and Herculean strength, strained every available muscle to give momentum to that sledge, but all in vain. The shaft obstinately refused to move. Then the thing was blocked up with the shaft in a horizontal position, and a heavy iron bar, with as many men as could stand on each side, was used as a ram, but in vain. By this time the end of the shaft had been hammered down to about level with the casting. The next move was to apply two 2 inch bolts, so that the pressure exerted through them would bear on the end of the shaft, with provision for adding to this pressure the force of the aforesaid battering ram, but even this combination was not a match for the staying powers of that shaft. Of course, the reader knows, as I knew, that by this time the shaft had been upset till the outside of it was jammed into the grain of the casting for about the whole length of the fit, 8 inches or 9 inches, and that every blow applied to it made it less likely to come out.

By this time all idea of getting it out had been relinquished, the team had gone back, and they were discussing whether it would be cheaper to split off the crank and make a new one, or drill out the shaft and make a new one. I had been thinking out a scheme, and told the foreman that I thought I could take it out. He reported what I had said to the superintendent, who came to me, and, after a little talk, told me to call what help I wanted, and try it.

We took it outside, dug a hole in the ground, and set the end of the shaft down into it. Raising it about a foot or more, we put some good blocking under the crank, laid a floor of plank on the blocking, put three or four inches of molding sand on the floor, and let the crank down on to it. We filled in sand against the inside of the rim, and level with the top of it, leaving a space 6 inches wide and 8 inches deep between the sand and the hub on each side. We built up a stage about 10 feet high over the crank for men to stand on, and got a bar of iron up into place to drive on the shaft. By this time iron was running in the foundry, and the boys poured a double hand of it in on each side of the hub. We waited till the iron had stiffened, so that it would not run out if we broke up the sand, and then, with three or four men on the stage, and as many below, we brought the bar down on the shaft, which started at the first blow, and half a dozen more drove it out. The casting around the hole was not so hot but that I could hold my hand to it with little discomfort.

The reasoning which led me to adopt this scheme was something like this: The term cast iron is often used as a figure for absolute rigidity, but it has no such property. It will come and go according to circumstances, and it will offer very little resistance to coming and going *a little*. I thought that if I heated the outer part of the hub, as soon as the heat had penetrated it sufficiently, its expansion circumferentially would expand it diametrally, but it could only do so by pulling away from the shaft the cold, or cooler, metal immediately around it, thus enlarging the hole and freeing the shaft. I did not think it necessary to heat the hub "just to the joint and *no farther*." I depended upon the accommodating character of cast iron to help me out there. I may say that the surface of the shaft was jammed into the grain of the casting for ⅓ or ¾ of the length of the fit, as it never could have been in a shrink fit, and that probably the driving done on it in taking it out at last did not amount to half of one per cent. of what had been done before the heating.

In planning this scheme my premises may have been false, and my reasoning illogical, but my conclusion was all right.

St. Johnsbury, Vt. T. HODGSON.

Common Nonsense in Trade.

Editor American Machinist:

Although this subject is not one directly relating to mechanical things, still it is so importantly connected that I think you may make room for it in your paper.

In calling the matter nonsense, I do not pretend to say which side the cause of nonsense rests upon, but simply to point out that there is nonsense somewhere.

See a machine, tool, or other thing advertised and write for description and price, and in many cases you will receive a very good description, but when you want to find out what it can be bought for, and refer to the price list, you find the prices very high, but "*subject to discount*," and as you have not been supplied with discount sheets, you might as well not have been supplied with a price list, for it is of no use to you whatever.

This matter to a certain extent is, of course, all right. The cost of manufacture changes at times, and it is easier to change discounts than list prices, but when it comes to setting a price upon a thing that is never intended to be the selling price, but twice as high as any one would be crazy enough to pay, and then making a discount of from 50 to 90 per cent. on the start, it looks to me like a case of nonsense somewhere.

If a buyer would rather buy a thing at $5 and 50 per cent. discount than at $2.50 and no discount, then it is evident that the foolishness rests with that buyer.

I would not be surprised to see some people list a tooth pick at $100 and then offer $99\frac{99}{100}$ per cent. discount. There are two ways of conducting business—one is on the "square," and that is to first find out what price would allow a fair profit, and then be satisfied with it, and the other way is "hoggish," that is, not to know what you will be satisfied with, but be very care-

ful to get every cent that any one, by any means, can be made to pay. A motive of greed will cause a man to list a hammer valued at $1 at $10, and then take that amount for it if he can find any one green enough to pay it, or if not green enough to pay $10 then just as near $10 as his greenness will allow.

Many men follow this plan because it is the established custom, but I am pleased to notice that there are some—and the number is growing—who have left this old, greedy worn out track for something nearer fair, and vastly more sensible. As in any other new thing, there are obstacles in the way, but it is safe usually to pursue a fair and sensible way, even if it is a little out of the established custom.

There are many things that in "trade" are considered all right, that a similar amount of dishonesty in other directions would place the operator behind prison bars.

Suppose I go into a store to buy a suit of clothes. I expect to get fair value for my money, and I also expect that the dealer will make a fair profit, but what about my expectations? The first thing the dealer does is to "size me up." He is a student of human nature and has made it a study and a very important side line in his business for years. He is not satisfied with a fair profit on his money invested and fair pay for his time, if he can make his skill as a "lingo slinger" bring more. If he thinks, after giving me a close examination, that I am a person who might pay $25 for a $3 suit then $25 is the price, and then if he tries this and fails, then he tries a lower price, and by a system of acting and trade smiles, he finally sells at a profit of some kind, and rests contented, for he feels that he got all he could. This clothing dealer does not have every thing his own way, for people have learned his tricks; they go into his store to buy 25 cents worth of goods and feel quite satisfied if they succeed in striking a satisfactory bargain in two hours' time (at 25 cents per hour). I know a prominent lawyer who spent eight hours' time, and must have traveled at least 10 miles in buying a pocketbook for his boy at 25 cents.

Perhaps if he had bought a piece of leather he might have supplied the dealer in that time and with less real work, but he was learning human nature.

It is upon such a foundation that this high discount plan is based.

When people come to reckon their time and add the bill to some of these great bargains got by dickering the matter will look quite different. The file manufacturers have adopted one price list, but their discounts so modify the lists, and are so changeable that the price list is of very little consequence.

If the milk dealer is caught pumping water into his milk from a strictly "*business*" motive, he is arrested, for this sort of *business* is not popular, but a man can buy $100 worth of ordinary stock, and adulterate it with human nature, skill, trade smiles and choice lingo and make more money than the milk dealer ever dreamed of.

Business is business and robbery is robbery, and if a person does not either go to heaven or to jail for his various offenses, then he does not get what he deserves.

A MECHANIC.

Self-propelling Fire Engines.

Editor American Machinist:

I have read with much interest the articles on the above subject, and would like to add my own opinion to those already expressed.

Here in Chicago fire engines are often sent to fires a mile or more distant.

A "small cylinder of compressed air" would hardly do for such a case. Now, if we discard the boiler and substitute larger reservoirs and self propelling mechanism, as Mr. Neuert suggests, we have an entirely different machine, and one which, if the increased amount of air can propel it at the required speed for a sufficient length of time, would be well worth considering after compressed air has a wider use than at present, say, after it is used for propelling street cars.

But at present when the electric motor is accomplishing so much that several of your correspondents are trying to accomplish by means of compressed air, the electric fire engine described by Mr. Neuert is likely to be considered first. There is nothing new about this engine. I saw a photograph of one over two years ago, and if I am not mistaken several of them were in use in Berlin.

Judging from the photograph, they were much lighter than the steam fire engine and probably just as efficient, and were easier to get to work and more economical.

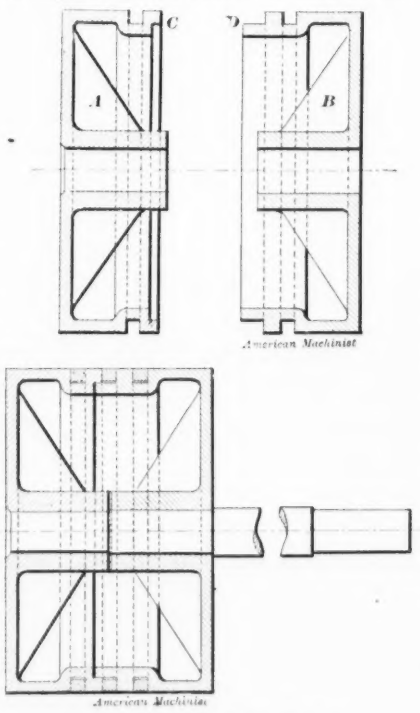
These systems are, of course, only for the more densely peopled parts of large cities.

Now, I am not yet a mechanical engineer, I am just what I sign myself to be, but I think that from an engineering standpoint the best thing would be to abolish the fire engine altogether. Build a central power station equipped with pumps and accumulators, and lay heavy cast iron mains. It would be practicable to keep water in these mains at a pressure of 800 pounds per square inch.

The highest pressure obtainable with a good fire engine is about 240 pounds. These mains could be laid in all the principal streets, where there is the greatest value in the most confined space, and would give a practically continuous fire engine, having an unlimited head in place of the few feet we now have. A special form of hydrant would have to be used for this pressure, and each hydrant would be as efficient or more so than a single fire engine.

Nor would the above system be of use only for extinguishing fires. It could be used in depots and on docks for operating hydraulic cranes, in office buildings for elevators and lifts, and could be changed into rotary power by means of Pelton or other water wheels or motors, and used for dynamo-driving and many other purposes. It would be especially valuable when used for small rotary motors, as with a small machine and this high pressure a large amount of work can be done with a small amount of water. I see no reason why this system is not in use here, for it would prove a very good investment for capitalists.

The AMERICAN MACHINIST has several times advocated the more general use of ball-bearings by engine and tool builders, and I see that the Lodge & Davis Co. have used ball-bearings to quite an extent in their new motor-driven radial drill, which ought to prove a very good machine. Why don't tool-builders use ball-bearings to take the end thrust on their lathe spindles, and for many other purposes? THE CUB.



Two-part Hollow Piston.

We have been favored by H. Bollinkx, Society Anonyme, Brussels, with a blue print, from which the engraving representing the steam engine piston adopted at these works has been made.

It will be observed that the piston is made in two pieces, *A* and *B*, which pieces are easy to cast. These pieces are fitted together, as indicated, the fit being a tight one, so as to make practically one piece, with a steam-tight joint between the parts. The rod is forced to place by hydraulic pressure, the indications of the gauge showing what pressure will be required to start the fit.

In regard to this plan of making hollow pistons it may be observed that making the casting in halves brings about the certainty of equal metal all around, and also the certainty of a clean inside. When casting in one piece, with holes through the sides

AN INTERESTING GEAR WHEEL.

for anchoring the main core, it may happen that the core may shift, leaving the metal dangerously thin on one side. In the instance of large cores, requiring a frame, which must be removed in pieces through the holes in the sides, it has happened that a piece has not been removed, the result being that in time it has worn a hole through the wall of the piston.

Mr. Bollinkx writes us that they favor the putting together of all tight fits of their engines, large and small, by hydraulic pressure. Thus their fly-wheels are made in two pieces, the pressed fit being depended upon to hold them in place on the shaft, the halves being simply bolted together.

A labor difficulty was settled in Boston the other day without friction between the workmen and their employers, and after a fashion that was mutually satisfactory. The record of the affair might be studied with advantage in other cities by those who have to do with labor in any relation. A disagreement occurred between the bricklayers of the city and their employers on the old question of wages. The men, not waiving their demands, continued at work. There had been keen competition in the building trade for several months, and, owing to the narrow margin on which the contractors had to do business, they did not think that they could pay the men more than 35 cents an hour. The men wanted 45 cents, and the controversy was referred to a board representing both parties. The arbitrators could not come to an understanding, and the situation was ripe for a lockout or a strike. It was decided, however, to make another effort to reach a settlement. The whole matter was accordingly submitted by the arbitrators to Mr. William Lloyd Garrison, as referee, whose decision it was agreed should be accepted. The referee fixed the wage rate at 42 cents an hour, which the bricklayers are now receiving for their labor. Not a day's work had been lost by the men or the contractors, and no one in the community was any the worse off for the dispute between them.—*The Evening Post.*

Mineral Resources of the United States.

The tenth report of the mineral resources of the United States, embracing the calendar year 1893, has been issued, and it gives evidence of a good deal of intelligent labor in its preparation. From this report it is learned that the mineral products of the country were smaller for the year under consideration than for any year since 1889, being 11½ per cent. less than in the preceding year. This decline has been fairly well divided, although most noticeable in pig-iron and structural materials. In petroleum there was an increase in value, but a decrease in volume, the reverse of this being true in the instance of bituminous coal. The amount of gold produced was greater than in any year since 1886, the increase being mainly in Colorado.

The number of completed blast furnaces in the country in January, 1894, was 519, as against 569 in January, 1892, but the capacity of the 519 is materially greater than of the 569. Not one new furnace, it is said, is now being built.

The annual converting capacity of the Bessemer steel plants built and building has increased from 5,857,143 tons to 7,740 900 tons, and the annual capacity of the open hearth steel plants from 1,383,929 tons in January, 1892, to 1,740,000 tons in 1894.

The production of Bessemer steel rails in 1893 was the smallest since 1885.

In the production of iron ores there has been but little change in the relative positions of the States as between 1892 to 1894. Virginia has risen from seventh to fifth place, while Tennessee and New Jersey have changed places, the former falling back, and the latter advancing one place. Both States have actually fallen back, as compared with production in 1892.

Some space is given to the problem of smoke prevention, the statement being made that in St Louis this is practically accomplished. In that city an association of some 1,800 prominent men was formed to deal with the question, and the conclusion is reached that this accounts for the results. Some account of the means employed to prevent smoke is given, but there is nothing new in the ground gone over. Some of the best means of preventing smoke are said to result in fuel economy, because cheaper coal can be burned. Altogether a good deal of useful information is given in the report.

* An Interesting Gear Wheel.

We present herewith a reproduction of a photograph of a gear wheel which has some points of interest to mechanics. This gear wheel was made by the Geo. V. Cresson Co., of Philadelphia, and is to form part of a 20 inch pipe-mill which is being built by that company for the Tasker Pipe Association, of South Bethlehem, Pa. The mill will weigh about 60 tons.

The gear is 7½ feet diameter, and is a spur wheel and two bevel wheels combined in one piece and forming a single casting.

It will be driven by a pinion, which will engage with the spur teeth, and there will be five steel bevel pinions on each side engaging with the bevel gears, the purpose of the arrangement being to control the rolls used in the mill. The gear was molded in a gear-molding machine without a full pattern, and is a very good example of what can be done with modern foundry appliances.

AMERICAN MACHINIST

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☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

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☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

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NEW YORK, JULY 26, 1894.

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"Changing Machine Designs."

A correspondent, on another page of this issue, brings up the old question as to the policy of modifying standard machines to suit the ideas of customers. Generally speaking, in this country the objection of manufacturers to alterations in standard machines amounts to a strong prejudice. We have known of firms losing important orders because they would not make slight changes in one or two of the machines wanted, these alterations being such as would not in any way disturb the patterns, and, moreover, any extra cost incident to the alterations would willingly have been paid for by the purchaser.

The manufacturer is likely to reason that he has devoted a good deal of time to the design of his machines, and knows best of their adaptations to the requirements, and in this he may be right, but, on the other hand, the purchaser may insist that he is the best judge of what he wants, and is willing to pay for.

From the manufacturer's point of view, it may be said that alterations that are for the worse rather than the better will injure his business, a poor machine standing as a perpetual advertisement of bad design, for which he gets the credit, and which will injure his trade for years to come. And, beyond doubt, it will so stand, notwithstanding the purchaser asserts that he is willing—and really is willing—to take all responsibility of the changes that may be made.

When the purchaser insists upon alterations, the manufacturer is likely to look upon it as an insinuation that he does not know how to build his own machines, and he may, sometimes with good reason, as previously intimated, fear that it will harm him to an extent much greater than will be covered by the profits of the sale, while the purchaser is not likely to forego his right to have what he wants, if he pays for it.

It is a vexed question, in whatever way it is looked at. There are, no doubt, many instances in which the manufacturer cannot at all afford to depart from his usual practice. As, for example, let the machine be a steam engine with an established reputation. Now, it stands to reason that the builder could scarcely be paid to make alterations at the suggestion of another that would make an unsatisfactory operating machine of it. The fact would always stand out that he built it, and it was not a good engine, and it would be likely to do him more harm than a dozen good ones would do him good.

Manufacturers are not infrequently accused of uppishness because they will not make changes in standard machines to suit customers, but when they will not do so they generally have, or at least think they have, good reasons for refusing.

Instances may and do occur in which purchasers ask for a change that is entirely innocuous, a change for which the machine will be neither better nor worse. Even then the manufacturer may take exception to the appearance of vacillation indicated by the change, as being likely to harm his business by giving an impression that he is not quite certain of what he is doing at any time.

There is still another way in which the matter may be looked at. There are manufacturers who see something besides dollars and cents in their work. That is, while there are manufacturers who see nothing in their business but the money to be made at it, there are others to whom poor product would be a perpetual nightmare; those to whom the credit of good work is of more consequence than getting rich, because they get more satisfaction from it. They feel that their product stands, as it were, a part of their character. They attach a moral value to it. With such manufacturers making a change that would make of the machine a poorer one would be about equivalent to lying in business, or something of the sort. As we have said before, the question is a vexed one, and can hardly, we should think, be covered satisfactorily by any single ethical covering. Some light, however, may be thrown on the matter by those of extended experience.

Milling Machine Feeds.

A correspondent whose letter appeared in a recent issue of this paper touches upon a subject which pertains to what may be regarded as a curious aberration by those who have been concerned with the development of the milling machine.

If we consider the lathe we find that a given lathe tool will stand to remove a chip of a given thickness; which may be one thirty-second of an inch. Under ordinary conditions it will take this chip at a speed of about twenty feet per minute; which means that if the work is a little over six feet diameter it must revolve one turn per minute, while if it is a little over four inches diameter it must revolve about twenty revolutions per minute. But in order that the thickness of the chip may remain the same the feed per revolution must remain the same; which indicates that the feed motion is properly taken from the spindle, and that it is right that the actual speed of the feed belt should, other things being equal, be reduced or increased with the reduced or increased rotative speed of the spindle and the work; or, in other words, that the feed should, for like conditions as to character of work and cut, have a fixed ratio to the spindle rotation. The same reasoning applies to most other machine tools—drill presses, boring mills, etc.; but it does not apply to the milling machine, and yet milling machines are made as though it did apply. It will be admitted that each tooth of a milling cutter four inches diameter should be expected to take as heavy chip as can be taken by each tooth of a cutter two inches diameter, if the teeth are of the same pitch, if the cutters run at the same surface speed, and do work of the same character. Under these conditions the same number of teeth strike the work per unit of time, and the feed should therefore be the same per minute, notwithstanding the fact that the smaller cutter must run twice as many revolutions per minute as the larger one; which means that the feed per revolution of spindle when using the larger cutter must be twice as much as when using the smaller cutter.

Stated differently, we may say that lathe feeds and milling machine feeds agree in so far that they should, under unvarying conditions as to character of work, cut, etc., remain the same for a given cutting speed, but they differ in that while the rate of lathe feed, under equal conditions, varies with the rotative speed of spindle, the rate of milling machine feed should, under the same circumstances, remain constant regardless of rate of spindle rotation.

This points to the cone pulley as the proper source of the feed motion in back-geared milling machines rather than the spindle, and, in fact, indicates that feed motion should be derived from some part of the machine having a uniform rate of rotation, independent of spindle rate of rotation.

Such an arrangement was advocated in our columns 10 years ago (issue of September 20, 1884), by Fred J. Miller, and the reasons for its adoption given, since which time a few users of milling machines have adopted it by making the necessary changes, and have found it very satisfactory.

The "high speed attachments," which have been brought out since that time to obviate the difficulty with small stem cutters, pointed out in the same article, have, at the same time, helped somewhat in the matter of feeds because they run small cutters much faster without increasing spindle speed.

We hear a great deal nowadays about the cheapness of living as compared with twenty or thirty years ago. This may possibly be true in some localities, but we must confess to not knowing exactly where. Take New York for example. *The Sun* is authority for the statement that board for mechanics here was formerly from two dollars and a half to three dollars a week, and that now the same kind of board is five and six dollars. And about the same proportions prevail in the instance of a mechanic who has to rent rooms for a family. *The Sun* accounts for this increased cost in living in the increased value of land, which, no doubt, is true.

In the same line of thought the remarks of a manufacturer in a Connecticut city may be noted. They were to the effect that it was sometimes convenient to patronize a little corner blacksmith, but that his charges were so high that it was rather ruinous to do so. But, he remarked, the blacksmith is not to blame. He has to pay more yearly rental for his little place than a clear title to it is worth.

The "Minneapolis."

The "Minneapolis," the latest "commerce destroyer" added to our navy, developed on her trial trip, which took place on the 15th, a speed of slightly over 23 knots; which makes her the fastest vessel we have, and secures for the Cramps, her builders, a speed premium of over $400,000; her guaranteed speed being 21 knots, with a premium of $50,000 per quarter-knot excess. The contract price of the "Minneapolis," exclusive of her armament, is $2 690,000. She is 412 feet long, 58 feet beam, and has a displacement of 7,350 tons. There are three manganese bronze screws, each driven by a separate triple expansion engine, designed by the Bureau of Steam Engineering. The engines have cylinders 42 inches, 59 inches and 92 inches diameter, and 42 inches stroke, and the maximum steam pressure is designed to be 160 pounds. During the trial run a speed of 137 revolutions was attained, the average for the run being 137, the horse power being approximately 21,000. Everything is said to have worked very smoothly and satisfactorily.

It begins to dawn upon those intrusted with the testing of steam boilers in New York City, that the hydrostatic pressure test as applied is not satisfactory by itself, and hence there is a movement looking to a change in the law in that respect. No change, however, can be made until the legislature meets again. It has always been known by engineers that the hydrostatic test alone was of little or no value so far as the safety of a boiler for any considerable length of time was concerned, one reason for this being that the boiler, in some of its parts, may be in such a state of corrosion that, by the continuance of the wearing away, it would be quite unsafe in a few months after the application of the pressure test. And it may be in such condition as to be strained in some of the worn-away parts to the extent that the pressure test only increases the danger of letting go. A thorough internal and external examination of a boiler is the only "test" worth mentioning, after which the pressure test is not particularly objectionable.

From all over the world, so to speak, come accounts of some remarkable clothing that, worn by a soldier, will protect him from the bullets of the enemy. No one appears to stop to consider that a soldier clothed in this armor would be in about the same condition—so far as marching and fighting is concerned—as the redoubtable Falstaff, as portrayed by some of the ablest impersonators on the stage. We suppose that about every soldier who enlisted for the late war from Massachusetts, and probably from a good many other States, was importuned to buy a bullet-proof vest, which vest consisted of a steel plate covered with cloth. And every soldier who bought one threw it away not later than the second day's real march he was engaged in. A soldier might be protected against hostile shots in a good many ways, in which he wouldn't amount to anything in particular as a soldier.

Literary Notes.

THE USES OF COMPRESSED AIR. By Addison C. Rand.

The author, a recognized authority on compressed air, indicates in this little volume the utility of air as a motive power, and gives a comprehensive and interesting account of the important uses which have been found for compressed air, within a comparatively short period, such as tunneling and drilling, pumping, operating shops, tools, guns, aerating, atomizing, and its usefulness in railroad service. The book is not intended as a scientific exposition, its contents are simply descriptions in a common-sense way of the principal uses of compressed air, and its wide range of application may be a revelation to some readers. The illustrations have been carefully prepared, and are very fine, in fact, the whole is handsomely gotten up. The book is published by Republic Press, 14 Lafayette Place, New York. Price, $1.

T. Dunkin Parett, president of the Tanite Co., Stroudsburgh, Pa., has issued in pamphlet form a lecture delivered by him and printed in the *Journal of the Franklin Institute*. The lecture consists of the getting together a good deal of what is known, ancient and modern, about emery and its uses. It is a very interesting little pamphlet which, we presume, can be obtained from the Tanite Company.

Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(343) J. J. H., Plainfield, N. J., writes: Please inform me how umbrella ribs are made, are they pressed or rolled? *A.*—We presume they are rolled.

(344) W. H., Bayonne, N. J., writes: Please advise me if there is any book published treating on photo copying drawings, and from whom it can be obtained. *A.*—"Modern Heliographic Processes," by E. Leitze, can be obtained from any dealer in scientific works.

(345) F. H. F., New York, writes: Kindly inform me as to the number of horse power that is generated by live steam passing through a 1 inch (nominal) pipe under a boiler pressure of 60 pounds per square inch. *A.*—The weight of steam discharged per minute through a 1-inch pipe, whose length is 240 diameters, is 4.32 pounds. Multiplying this quantity by 2 we have 8.64 horse-power.

(346) G H. C., South Framingham, Mass., writes: Kindly inform me if there is any book published giving a complete description of all the vessels in the U. S. Navy? *A.*—The most reliable description of all the new vessels in the U. S. Navy you will find in the reports of the transactions of the Society of Naval Architects and Marine Engineers. Address, Secretary and Treasurer, 1710 F Street, N. W., Washington, D. C.

(347) X. Y., ——, asks: How would you construct the piston and packing for a hydraulic machine, mercury being the fluid, so as to prevent any leakage of mercury with a pressure of 40 pounds per square inch? *A.*—We should use a plain cast iron ram, having a diameter nearly equal to that of the cylinder, and use leather cup packing fitted into a cell made for its reception in the interior of the cylinder; in fact, we should adopt the construction of an ordinary hydraulic press, as illustrated in many textbooks on mechanics, or in any elementary treatise on physics. Your other questions are answered in our issue of July 12th.

(348) C. S., Bridgeport, Conn., writes: Please give me a short description of the method of bending ½ and ¾ inch steam pipes into a spiral coil about 6 inches diameter, the coils are to be about 3 inches apart, they will have to be bent when cold? *A.*—These pipes can be bent to the desired form on a mandrel revolving in a lathe. 2. In a previous number of your paper, about a year ago, you published a short notice of an article treating on coil boilers, by Chas. Ward, and read before the marine and naval engineers. Please give his address so that I may get the article. *A.*—Write to Ward Marine Boiler Works, Charleston, Kanawha County, W. Va.

(349) R. J. S., Centerville, Ia., writes: Please answer the following question in regard to pumping water from a well 2 600 feet deep, with water at 250 feet from the surface. We wish to put in our city a pump that will answer for a fire pump. Is there any pump on the market that will force the water from a well as deep as this? The well is 8 inches diameter. *A.*—There are deep well pumps on the market adapted for forcing water out of wells of great depth, but it is doubtful whether you can get a pump of this kind to suit the small diameter of the well, you may have to get special patterns made. We should, however, advise you to write to pump manufacturers; the addresses of some of these are given in our advertising columns.

(350) W. G. N., Chicago, Ill., writes: Kindly inform me as to height and diameter of a chimney which you would recommend for a standard return flue horizontal boiler, bricked in, containing 600 square feet of heating surface, and 16 square feet of grate surface; tubes are 2 inches in diameter. A very ordinary grade of Illinois soft coal is used as fuel. Average steam pressure desired is 65 pounds. *A.*—We should use a chimney 21 inches square, and 80 feet high. 2. Do you consider there is sufficient advantage in a round chimney over a square one to recommend a somewhat expensive change? *A.*—There is very little difference between a square and round chimney as far as draught is concerned. Square chimneys of moderate cross section are cheaper to build.

(351) W. E. G., Buffalo, N. Y., writes: I have the chambering of gun barrels to do. My reamers do not work as smoothly as I wish. The last reaming should leave them as smooth as glass. I have been using straight fluted reamers. The barrels are about .016 inch, tapering in 2⅝ inches. Can you suggest a change in the reamers that will secure greater smoothness? *A.*—We are not sure that we can without knowing more of the conditions. If a fluted reamer is used, it would be better to make the flutes spiral, and they should have very little backing off. Lubricant should be very plentifully used. If not successful otherwise, we should use a square reamer with blocks of wood upon it, made similar to those used for reaming the bore and should finish with this, taking, of course, a very light cut with it.

(352) E. F. V., Montreal, Canada, writes: I shall have to place an exhaust fan on two molding machines, one on a buss planer, and one on a large door planer, with sand wheel. My employer wishes me to use a tube 8 inches diameter for entrance and exit; the manufacturers' catalogue gives 234 square inches for the area of the exit, and 200 square inches for the entrance, which gives diameters of 17¼ inches, 16 inches. I would like to know if the fan will carry away the shavings with as much force through the small tubes as in the tubes of the size required by the manufacturers. *A.*—The force in the smaller pipes will not be as great as in the larger ones, and the discharge through the smaller ones will be reduced. 2. In regard to speed, the catalogue gives from 2,500 to 3,000 revolutions per minute. My employer wishes me to use the pulleys which he has in stock, and these will give us a speed of 2,200 revolutions per minute. Will this do? *A.*—The decreased speed will reduce the quantity of discharge. We should advise you to follow the instructions given by the manufacturer of the fan. Your third question we cannot understand without a sketch. We cannot furnish a copy of our issue of December 1, 1888, we keep no stock prior to 1893.

(353) A. F. G., Chicago, Ill., writes: I would like to know if a one horse power engine is large enough to run a lathe 14 inches swing, and a shaper 18 inches stroke, both machines to run at the same time. If this engine is not large enough, please give dimensions of one that will be large enough, that is, diameter of cylinder, length of stroke, steam pressure, number of revolutions, and size of crank shaft. *A.*—The power required to run these machines will depend upon the speed, the amount of work done, the particular design and construction of the machines. The character of the work to be done may also affect the power required to operate them. From this it will be seen that the estimate of power can at best be an approximation only. We should use an engine of not less than 2½ horse-power, having a cylinder 3 inches diameter and 4 inches stroke, running at the rate of 400 revolutions per minute, with a mean effective steam pressure of 40 pounds per square inch; crank shaft 1½ inches diameter. 2. Give size of an upright boiler suitable for this engine. *A.*—We should use a plain upright boiler without any flues; outside diameter of shell, 32½ inches; height (not including ash pit) 79 inches; inside diameter of furnace, 27 inches; height of furnace, 44 inches; diameter of flue, 9 inches.

(354) A. D., New Orleans, La., writes: I want to put in a keel condenser on a boat 22 feet long and 4 feet 5 inches beam, whose engine is 3½x5 inches, to run at a rate of 250 revolutions per minute, with a steam pressure of 150 pounds per square inch. What size of pipe shall I put in? I remember seeing a year or so ago a statement from the U. S. Navy officers that where a keel condenser is used the pipe should be about twice larger where it is connected to pump than at the other end, giving it a gradual taper from engine back to pump; this, it was said, is necessary for the satisfactory working of the condenser. Is this so? What horse-power will the engine develop? And will not an ordinary good boiler feeder be sufficient to take the place of an air pump? I do not mean to get as good a vacuum, but I simply wish to recover the condensed water. *A.*—The engine will develop about 5 horse-power. Allowing one-third of a square foot of cooling surface per horse-power, you will need a pipe of such a diameter and length as to give 1.7 square feet of cooling surface. It is possible to run the engine without the air pump, but the close regulation which a boiler feeder requires in connection with a keel condenser and without the use of an air pump may lead to very unsatisfactory results. It is essential for the satisfactory working of the keel condenser that the delivery end of the tube should not exceed one half the diameter of the receiving end, for if a larger diameter be given to the delivering end, a part of the exhaust steam will pass directly to the air pump over the water of condensation in the tube. The delivering end of the tube must be small enough to remain completely filled with water for the exclusion of the steam from the pump. The steam yacht "Leila," on which experiments were made by a number of United States naval engineers, had an air pump attached to the keel condenser, the latter being considerably below the air pump. The condenser consisted of a single copper pipe 5 inches inside diameter at the exhaust steam end, and 2 inside diameter at the pump end. 2. Where a boiler is made of small 1 inch coils or pipe all in an intense heat with free circulation, how many square feet of heating surface will be required per horse power? I know that 10 square feet is a frequent allowance for water tubes, but in such small pipes is not 5 or 6 square feet of heating surface per horse-power sufficient? *A.*—In boilers made of 1-inch pipes, 5 or 6 square feet of heating surface per horse-power may give all the steam required, but in our opinion the life of the boiler will be shortened, from the fact that if 5 square feet must do the duty of 10 square feet the life of the tube will be reduced. We do not favor using pipes of 1 inch diameter, as boilers made of this size of pipes are generally dangerous affairs. 3. With very fine lines on the above launch, propeller being 22 inches diameter and 44 inches pitch, is not a speed of 8 or 9 miles per hour probable? *A.*—Yes.

(355) P. L., Fitchburg, Mass., writes: You have given a formula for the velocity of flow of water through pipes, which reads,

$$v = \sqrt{\frac{2 \times g \times h}{1\,5 + f \frac{l}{d}}},$$

I can see that $\sqrt{2 \times g \times h}$ is the theoretical velocity, and this would be obtained if there had been no resistance due to friction. I can also see that $f \frac{l}{d}$ makes the allowance for friction, but I do not understand what the item 1.5 is used for. Please explain how 1.5 has been obtained? *A.*—Let h be the total head which causes the flow, when the discharge occurs freely into the air, and W the weight of water discharged per second; then the theoretic energy per second is $W h$; if now v be the actual velocity of discharge, the effective energy is $\frac{W v^2}{2g}$; hence the lost head will be $W\left(h - \frac{v^2}{2g}\right)$. It is more convenient to deal directly with the heads, omitting W; hence the effective head is $\frac{v^2}{2g}$, and the lost head is $h - \frac{v^2}{2g}$. This loss is due to loss of head at entrance, and the loss of head in friction. The loss of head at entrance is generally expressed by the following formula:

$$h' = m \frac{v^2}{2g},$$

in which h' = loss of head at entrance, and m, a coefficient, its value for inward projecting pipes is 0.93; when the end of the pipe is flush with the reservoir and has square corners, $m = 0.49$; and for perfect mouthpiece $m = 0$. When the condition of the end of the pipe is not specified, m is usually taken at 0.5. The loss of head in friction is generally expressed by the following formula:

$$h'' = f \frac{l}{d} \times \frac{v^2}{2g},$$

in which h'' = loss of head in friction, f = friction factor, l = length of pipe in feet, and d = diameter of pipe in feet. From the preceding we have,

$$h - \frac{v^2}{2g} = h' + h''.$$

Substituting in this the values of h' and h'', the formula becomes,

$$h - \frac{v^2}{2g} = m \frac{v^2}{2g} + f \frac{l}{d} \frac{v^2}{2g}.$$

By solving for v, we have,

$$h = \frac{v^2}{2g} + m \frac{v^2}{2g} + f \frac{l}{d} \frac{v^2}{2g},$$

$$h = \left(1 + m + f \frac{l}{d}\right) \frac{v^2}{2g}$$

taking 0.5 for the value of m, we have,

$$h = \left(1.5 + f \frac{l}{d}\right) \frac{v^2}{2g}$$

from which we get,

$$v = \sqrt{\frac{2gh}{1.5 + f \frac{l}{d}}}$$

which is the general formula for velocity of flow. You will find the whole matter explained in detail in the "Treatise on Hydraulics," by M. Merriman, an excellent book treating on this subject.

Business Specials

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

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"National" Lathe Chucks. Best made, page 15.

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A New Recording Pressure Gauge for Extremely High Ranges of Pressures.*

BY WM. H BRISTOL, HOBOKEN, N. J.

The gauge herein described and illustrated, although it may be adapted to ordinary ranges, has been designed especially for high ranges of pressures and to supplement the sinuous tube and diaphragm forms of recording gauges previously described. The principal object has been to produce a gauge which would withstand working pressures of 1,000 pounds or more, such as are employed on oil pipe lines and hydraulic press work, without taking permanent sets, and one in which the readings for increasing and decreasing pressures would be the same. The writer has had difficulty in finding an ordinary reading gauge for high ranges of pressure which has been at all reliable in these respects. In testing and standardizing high-pressure gauges the most satisfactory results have been obtained with dead weights carried by a cap covering an exact square inch of area. At the Stevens Institute for test work, where high

* Presented at the Montreal Meeting (June, 1894) of the American Society of Mechanical Engineers.

pressures are involved, a cylinder and plug of accurately known cross-section has been frequently employed on account of difficulty to secure reliable high-pressure gauges.

In Fig. 1 is shown the interior construction of a new recording gauge in which readings agree perfectly for increasing and decreasing pressures, over the entire scale. The spring part of the gauge consists simply of a Bourdon tube of flattened cross-section, wound into a small helical form of four complete revolutions. One end of the tube is rigidly fastened to a bracket with an opening for the pipe communicating to the gauge; and on the end, free to move by application of pressure, a pen arm *B* is directly secured. The diameter of the helical coil being only one inch, the actual motion of the free end of the tube is small, and as this motion is distributed through the four complete turns of the tube, it is evident that in the angular movement necessary to carry the pen arm over the scale of the chart, the tube itself is not strained to a point approaching its elastic limit. By this construction, the necessity of multiplying devices is entirely avoided. By varying the thickness of metal, the cross-section and the number of revolutions of the tube, a helix adapted to any desired range of pressure may be obtained even as low as five pounds per square inch for the whole scale. In the manufacture of the helical tube there is no difficulty in reproducing them to fit a standard chart, as illustrated in Fig. 2, which shows a complete gauge ready for application.

In this instrument, as in forms of recording gauges previously described, the pen, which is directly attached to the helical tube, records with ink on a chart revolved by a clock movement once in 24 hours. In Fig. 2 the total range is 1.500 pounds per square inch.

This gauge is the joint invention of Mr. E. H. Bristol and the writer.

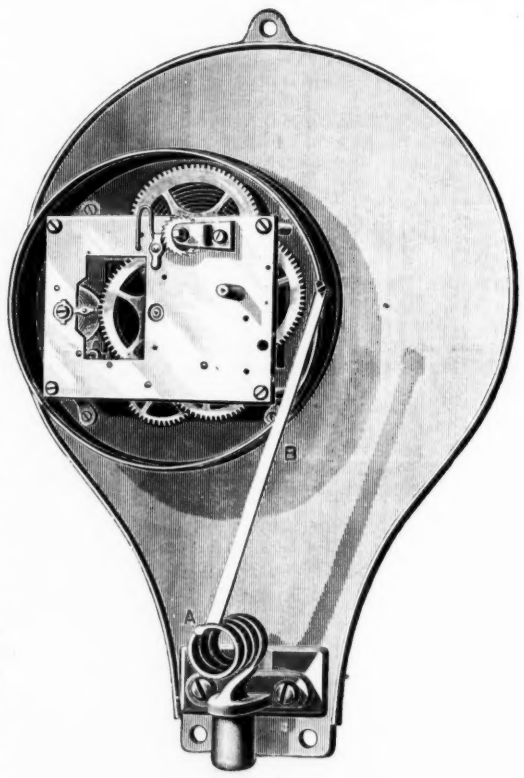


Fig. 1.

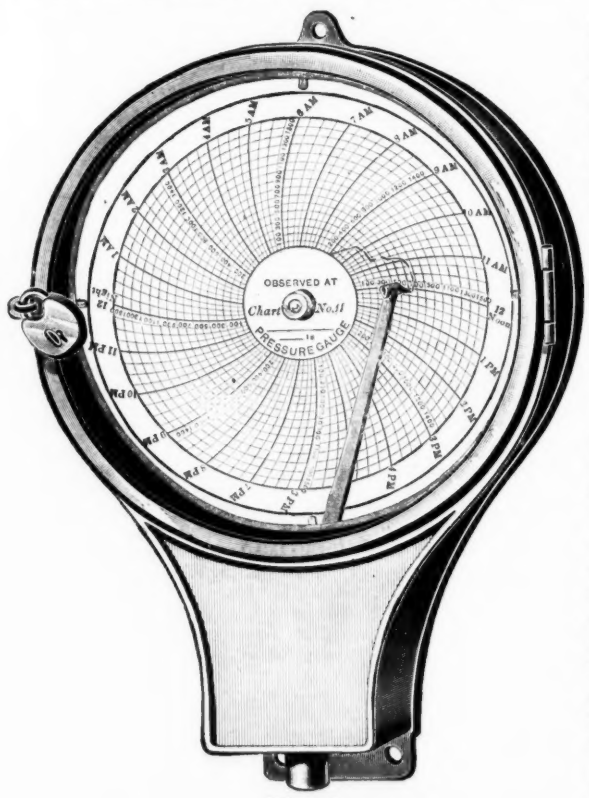


Fig. 2.

DISCUSSION.

This paper, though itself short, was the occasion for the longest discussion which took place during the meeting, much of it being the result of misunderstandings. Mr. G. C. Henning first expressed regret that the author of the paper was not present to answer some questions regarding the behavior of the Bourdon tube used in his gauge. Experience had shown, Mr. Henning said, that the Bourdon tube changed somewhat in use, owing, he thought, to the fact that it was composed of metal which had been formed cold by processes which set up strains within the metal, which strains showed their effects during the subsequent heating and repeated flexure of the spring. Because the spring used in this gauge contained more metal than is used in the common pressure gauge, he thought it might possibly be more susceptible to this influence.

Mr. F. H. Laforge said he had found the Bourdon spring very liable to change and give false readings, especially in cases where the gauge is fastened to an uptake or boiler front in such manner as to be considerably heated. He considered it important to avoid so placing them, and to take means of knowing, at frequent intervals, whether they were correct or not.

Mr. J. F. Holloway called attention to the very great importance of being assured that such an instrument was not only correct when new, but that it would remain accurate in service. An incorrect indication by such a gauge was much worse than no indication at all, because the incorrect indication would be depended upon by the unskilled and inexperienced to their detriment. He called attention to the fact that varying pressure caused the arm carrying the pen to swing to and from the center of the diagram paper, and that the moment of friction of the pen must, therefore, vary considerably, which, in a mechanism moved by delicate clock work, might possibly affect the accuracy very considerably. Considerable discussion took place on this last point without bringing out the fact that the moment of friction remained constant so far as the movement of the recording arm is concerned, and that, therefore, the amount of pressure indicated is not affected, but that what variation of frictional resistance took place could affect only the clock movement, and, therefore, the recorded time of a given pressure; which, since time could not be read on the dials to less than five minutes, would practically amount to very little. It was also explained that the design was to have the pen so adjusted, and to use ink of such a consistency as to make it unnecessary to have the pen actually touch the paper.

Mr. A. A. Cary recalled his experience with springs made of wire, and said that those made of what is known as "hard-drawn wire" would not stand as well as those made of tempered steel wire; he believed, mainly because the drawing operation set up internal strains within the wire, which strains were relieved in some measure by the constant motion given to the spring in use, and the spring, therefore, weakened.

T. R. Almond thought Mr. Cary was getting pretty near the root of the matter, and gave an account of some experience of his in coiling steel wire over an arbor of relatively small diameter compared to the diameter of the wire. He said: "I had a large quantity of wire to coil, and it was so hard that I was unable to coil it. It would continually break, and, in despair, I put it to one side, supposing that it was to be quite a serious loss to me. But it occurred to me that if I ran it through a bath of boiling water as it went into the coiling machine I might succeed. I rigged an apparatus so that it could be done in that way, and every bit of the wire has been coiled in that way without a single breakage, whereas before that the breaks would occur every few inches." The speaker explained, in answer to a question, that the wire referred to had been tempered by heating and quenching, and he thought the increase of temperature amounting to something like 152 degrees had simply permitted the molecules to more readily change their relative positions, which, of course, they must do when the wire is being coiled.

In answer to further inquiries, Mr. Almond stated that "the wire was No. 11 tempered steel wire, made by the Washburn & Moen Co., and the request was made in the order for a wire so hard that it would just bend over a mandrel .27 inch diameter. To get that, and have it so hard that it would answer my requirements, and yet not break, is a very difficult thing to do, and to return it to them, if it is too hard, brings about the condition that it may be too soft when it comes back. That is to say, thinking it is too hard, they get it softer than we really want it. . . . . I take it that if you warm a metal that has been compressed by hammering, drawing, etc., you help the molecules to arrange themselves, or bring themselves nearer to what we may call the normal condition, and whenever you do that you will get a stronger material."

In answer to a question, Mr. Almond said he did not think the temper of this wire was drawn appreciably, at least not in the ordinary acceptation of the term. "I do not think the temper is drawn in relation to the value of the material for cutting purposes, but it is, as far as strengthening the material is concerned. When I say temper, I mean drawing it so that it reaches some particular color with which we are familiar. I think that whenever you heat a metal, and also subject it to some vibratory action, you permit the molecules to arrange themselves according to a law, which undoubtedly exists, and by such an arrangement bring them into a condition which gives much greater strength to the material, and I think this will apply to any of the metals, within certain limits. We all know what a disturbed condition the molecules must be in after hammering, rolling, drawing, spinning, etc."

During the discussion Mr. A. A. Cary stated that it had been decided in a suit at law involving the point that, the temper of steel was not changed by any temperature below 300° F. He also sketched upon the board the arrangement in use at Cary & Moen's for tempering steel wire, consisting of an iron tank filled with lead, which was melted and kept at the proper temperature, the wire passing through this under rollers, out and into a tank close by filled with oil, and from this into a third tank with lead for drawing the temper.

Mr. Geo. R. Stetson mentioned the case of steel bars, which it was desired to break into short pieces, and it was found that by first plunging the bars into boiling water they broke more easily than when cold, and also much more regularly, *i. e.*, with a much more even fracture.

Now comes an alert critic who has discovered that the name of Dr. Isaac "Watts," of hymnal fame, has been chiseled on Boston's new public library among the list of great inventors, instead of the name of James "Watt," the father of the steam engine.—*Worcester Spy.*

Liquid Fuel in the Future.*

BY R. NELSON BOYD, M. I. C. E.

The use of liquid hydrocarbons as fuel dates back almost to the early development of the petroleum industry in America. Patents for the application of liquid were taken out in this country as long ago as the year 1863, and since then numerous systems for burning petroleum oil or refuse have been proposed. The most successful and generally applied is that introduced by Mr. Urquhart on the railways in Southern Russia, which consists mainly in breaking up or pulverizing the petroleum by means of a jet of steam. As the Russian oil trade increased, the tank steamers constructed to carry the oil from Baku to the mouth of the river Volga were arranged to burn petroleum residuum, and at present the numerous vessels employed in this trade burn nothing else Recently Mr. James Holden. locomotive superintendent on the Great Eastern Railway, has found great advantage in the use of cheap oil and gas refuse in conjunction with coal. Of late years the use of liquid fuel has been strongly advocated for steamers. The advantages claimed for this fuel are: Its great calorific power, its easy storage, and the economy in its application. The relative calorific values of coal and petroleum, according to Mr. Urquhart, are for coal 14,000 heat units, and for petroleum 18 600 heat units, equal to an evaporation of 16 8 pounds of water per pound of fuel. Professor Unwin recently made some experiments with the Priestman oil engine, and as a result gives the calorific value of petroleum under those circumstances at 25 per cent. over that of Welsh coal. American authorities give the theoretical calorific value of coal and petroleum as follows:

Bituminous coal.....	15,465
Anthracite.....	13,526
Petroleum.....	21,192

These figures show the calorific value of petroleum as about 40 per cent. greater than bituminous coal. In practice it has been found that a ton of petroleum is equal in effect to 2 tons of good coal. These different results may, to some extent, be explained by the varied composition of different kinds of oil. Petroleum as it comes out of the earth consists of a mixture of hydrocarbons with densities ranging from 0.60 to 0 95. The hydrocarbons belonging to the paraffin series have a general formula of $CH_2 + H_2$, and the relative calorific value will vary with the relative proportions of carbon and hydrogen, and if we take a hydrocarbon represented by the formula $C_4 H_{10}$ and $C_{18} H_{38}$, we find that the former contains 1 of hydrogen to 4 8 of carbon, and the latter 1 to 5.57 of carbon, and as the calorific value of carbon is 14,554, and hydrogen 62,030, expressed in heat units, the value of two such hydrocarbons will vary accordingly. Petroleum residuum, which is generally used as liquid fuel, would resemble the analyses of the paraffins of heavy density. In practice, any liquid hydrocarbon is treated as fuel, and on the Great Eastern Railway a general mixture of all kinds of refuse from gas works and residual oils is used. The results obtained on the Great Eastern Railway are very satisfactory. On the locomotives using liquid fuel there is an absence of constant and laborious firing, the requisite pressure of steam is easily obtained by an almost imperceptible movement of the injector valve, there is an absence of smoke, and a great uniformity of pressure. Mr. Goodwin, in his inaugural address, as president of the Society of Engineers, lately gave a description of the working and cost of these locomotives, and stated that an express engine using 35.4

*A paper read before the Civil and Mechanical Engineers' Society.

pounds of coal per mile consumed under similar circumstances 11.8 pounds of coal and 10 5 pounds of liquid fuel, or a total of 22.3 pounds of fuel, and according to these figures the liquid fuel is equal to twice its weight of coal. The advantages of liquid fuel are summed up as follows: First, that with an ordinary grate steam can be easily raised without working the injector. Secondly, fuel can be interchanged according to the state of the market. Thirdly, with a thin coal fire oil can be shut off at will without running the risk of chilling the fire box. Fourthly, when standing, the coal fire will maintain steam.

Now, if we turn to the experience gained with liquid fuel on board ships, we find an equal, if not a better result. The ships on the Caspian Sea have not used anything else for many years. The residuum is quite safe to use and to carry in large quantities, as it is quite non-inflammable until heated to 350° Fahr.; and as all the gases and lighter hydrocarbons are distilled off, it has no smell and does not evaporate at ordinary temperatures. There is a gain in the saving of labor for stoking and an increase of cargo space. The economy of bunker space is clear when we consider that a cubic foot of coal weighs 80 pounds, and a cubic foot of liquid 50 pounds, and assuming the latter to be twice as effective, a cubic foot of liquid fuel will equal 1¼ cubic feet of coal in calorific effect thus saving 20 per cent. of space. But in calculating the bunker space required, the proportion is even more in favor of liquid fuel. In round figures, a ton of coal takes up 42 cubic feet of space, whereas ½ ton of liquid fuel will occupy 22½ cubic feet.

Captain Carmichael, in a paper read before the Ship Masters' Society in 1891, estimated that a steamer 2,200 tons gross register, with 750 indicated horse power, on a trip of 105 days, would effect a saving of £2,336 by using liquid fuel instead of coal, taking the cost of the former at 40s. and the latter at 20s. per ton. This estimate includes the saving in wages and the gain in cargo space. This saving would, of course, not be so large in the case of a ship leaving Liverpool, for instance, with bunker coal, say, at 15s. per ton, and residuum oil at 2½d. per gallon, or about 60s. per ton, but even at these figures a saving would be effected owing to the gain of cargo space, the economy of labor, and the wear and tear of machinery.

These estimates have been based on the supposition that 1 ton of liquid fuel is equal to 2 tons of coal. But we have Professor Unwin's statement that petroleum oil yields 25 per cent. more calorific heat than coal, and this figure corresponds with the results given by Mr. Urquhart as the result of his experience on the railways in Southern Russia. On the other hand, we have the figures of Mr. Goodwin referring to the Great Eastern Railway, and find that 23 6 pounds of coal per mile have been replaced by 10.5 pounds of liquid fuel, giving a proportion of 1 of oil equal to 2¼ of coal. Again, if we take the calculated heat value of petroleum and bituminous coal, we get the proportion of 1 to 1.37. In order to reconcile these different figures, the author can only suggest that the petroleum engine does not in its present state, although greatly perfected, give the whole value of the fuel, and that Mr. Urquhart's figures are based on experience gained in the commencement of the application of liquid fuel to locomotives where probably the results obtained were not so good as they would be at present with more perfect apparatus.

Now, with reference to the theoretical calorific value of petroleum as compared with coal, the question to be answered is: How is the comparative value of 1 to 1.37 found sometimes in practice to be 1 of petroleum to 2 of coal? This, in the author's opinion, can be explained by the fact that the combustion of liquid fuel is almost perfect, whereas that of coal is not so. Obviously, a very considerable portion of the heat productiveness of coal is lost in the unconsumed particles of coal which are pparent in the shape of smoke, and there is generally, if not always, a certain loss in the unconsumed particles found among the ashes. Another and important point must not be disregarded, namely that the boiler tubes are always quite clean and not coated with a deposit of soot, and the full benefit of the combustion is realized. It is, therefore, not an exaggeration to state that in round figures 1 ton of liquid fuel properly burned for heating purposes will be equal, for practical purposes, to 2 tons of ordinary coal. The results obtained up to the present time in the use of liquid fuel have established the following facts:

1. That it is a safe and economically manipulated substance.

2. That its calorific value is much greater than coal, and consequently it offers advantages of less bulk, which specially affects shipping.

3. That its cost at present delivered in England is about 60s. per ton, which is equal to 1½ tons of coal in practical effect.

4. That the supply at that price is unstable, and that the supply is to be obtained from foreign countries only.

The advantages in its use are clear enough, and in order to secure its greater application the questions of cost and supply have to be taken into consideration.

However, even at the present cost of liquid fuel, it has an undisputed range of application. As an instance, the petroleum engine may be mentioned as a power producer. In many cases it is preferable to use a motor which does not require the erection of a boiler, entailing the use of a certain amount of space, and possibly the construction of a chimney or a flue of some kind. This specially is the case in mines, where space is costly, as it has literally to be cut out of the rock, and where boilers are only admissible on the surface or close to the upcast shaft the steam has to be conveyed for considerable distances. In mines such a motor is frequently almost indispensable, and has to be adopted, regardless of cost within certain limits. The competing systems for providing power under these circumstances may be taken as compressed air, electricity and petroleum. At the present time electricity appears to be gaining ground for this purpose, but the petroleum engine has a great point in its favor in the economy of first cost for plant. This advantage it also possesses on the surface, but here it comes into competition with gas. Professor Unwin, in his paper on petroleum engines, read before the Institution of Civil Engineers, gives the comparative cost of an effective horse power per hour as follows:

	Pence.
Large condensing steam engine	0 26
Small non condensing engine	0.77
Gas engine	0 86
Petroleum engine	0 50

In this table the cost of Welsh coal is taken at 24s. per ton, gas at 3s. per 1,000 cubic feet, and petroleum at ½d. per pound, which is equal to 4d. per gallon. All these figures appear to be high. Good engine coal in most parts of England does not cost 24s., gas can be obtained in most towns below 3s. per 1,000 feet, and 4d. per gallon for petroleum is an outside price. However, as all prices are taken at a high figure, the comparison is probably accurate, and it thus appears that petroleum is 41.8 per cent. below that of town gas. Water gas is, however, much cheaper than town gas, and the cost is given by Mr. Dowson at .89d. per effective horse power in a small engine, and other statements show a cost of 0.3d. per effective horse power. Thus the advantage of economy lies with water gas; but in order to obtain the benefit of it, the user must be in a locality where it is obtainable, whereas the petroleum engine can be applied in any situation where a cask of oil or a 10-gallon jar can be delivered. As a matter of fact, the number of petroleum engines in use is daily increasing, not only for mines, but for many other purposes. Apart from the question of motive power, a large field for petroleum is to be found in the homely stove, which is coming daily into greater use. This stove does not come much into competition with gas, as it is mostly used by people inhabiting houses where gas is not laid on.

With regard to the use of petroleum for industrial purposes in place of coal, practically nothing has been done in this country beyond the experimental stage, nor is there any prospect of petroleum being thus employed at the present prices.

Taking the most favorable estimate of the calorific value of petroleum—namely, that it is twice as effective as coal, and the lowest present price, say, 2½d per gallon—the cost will still be in favor of coal; thus 2½d. per gallon is equal to about £3 per ton, and taking this as equivalent to 2 tons of coal, the latter is able to compete at any price below 30s. a ton. Now, the selling price of coal in the centers of manufacture is certainly below 10s. per ton on the average. In certain industries, it is true that cleanliness, economy of space, absence of smoke, reduction of labor, may make up the difference, but for general purposes the advantage of economy at present is decidedly on the side of coal.

But there is another and very important point to be considered in dealing with the use of liquid fuel, and that is the question of supply. Although the quantity of refined oil or kerosene sent to this country is ample for lighting purposes, used either in lamps or for the enrichment of gas, this amount is small when considered as fuel. The importation of petroleum into the United Kingdom is over two millions of barrels per annum, equal to about 350,000 tons, which would represent the calorific value at most of 700 000 tons, which represents a small fraction of the consumption of coal. As regards steamships, it is quite possible that a development of the use of petroleum may take place in the near future, because they are in the position to take in their supply of fuel for a journey home and outwards at the seat of production—that is to say, at the eastern ports of America or the port of Batoum on the Black Sea. There are, however, two points to be noticed as against a general use of liquid fuel on board ships at present. One is the absence of any depots in different parts of the world on the track of steamers; so that, for instance, a steamer running from England to Australia would have to carry a sufficient quantity of fuel for the outward and homeward journey, unless a cheap supply could be obtained in Australia, which, however, is not the case just at present. Another point deserving attention is referred to in an article in the *Engineer*, on the recent journey of the tank steamer "Baku Standard" to Philadelphia. The consumption of petroleum residue or astatki used is given as 20 tons per day, and is estimated to have done the work of 30 tons of coal. The result of the trip was successful except as regards the serious quantity of steam used in "spraying" or pulverizing the astatki. The weight of steam required for this purpose exceeded the weight of astatki consumed, or about 1 ton per hour, so that considerably over 100 horse power was necessary to force the fuel into the furnaces.

However, both these objections can be remedied. The construction of oil depot tanks at convenient points along the ocean highways can be easily accomplished, and would soon be realized if the necessity arose. Then, again, the great waste of steam referred to is a matter which will find its remedy in some improvement or invention which is certain to follow a general want. Indeed, the attention of inventors has already been turned to this subject.

Lastly, as regards supply and cost, although petroleum is known to exist in almost every part of the world, it is only in a few favored spots that it exists in quantity, and practically only in two localities where it is largely produced, namely, in the United States and South Russia. This circumstance is in itself a bar to its general use in the Royal Navy, as in case of war the supply might be cut off, and our men-of-war, if depending on liquid fuel at sea, might find the tanks at the depots empty. Certainly, in reply to this it may be urged that if the tanks are empty the ships can take in coal, as the use of liquid fuel does not preclude the burning of coal. But in that case the full complement of stokers would have to be kept on board to meet such an emergency. This would certainly not suit the merchant service, where the economy of wages would be one of the primary inducements for the adoption of liquid fuel. It is not, however, at all impossible or improbable that we may some day get a supply from our colonies—notably from Canada—where large oil fields are known to exist at the present time untouched. The question of supply depends altogether on the development of the petroleum fields known at the present time and on the discovery of fresh deposits. Canada has already been referred to, and petroleum is also known to exist in quantity in many places on the Atlantic coast of America, in Mexico, and Venezuela. From these points a direct and cheap supply could be provided for this country. Of course, in speaking of liquid fuel as referring to petroleum, what is meant is the residuum which is left after the light oils and kerosene or illuminating oils have been distilled over—the substance which is known as astatki in Russia. It is perfectly safe for transport and handling in any climate, and admirably adapted for use as fuel. In countries like Mexico and Venezuela, where kerosene is imported and is subject to a high duty, the process of refining crude oil for the purpose of supplying the local demand for illuminating oil ought to be very remunerative, and leave the residuum as a by-product to be exported at a low price to Europe. Some development in this direction will no doubt some day take place, and then we may be able to secure a large supply of liquid fuel at such a cost as to enable it to be applied to industrial purposes in this country.

"Stuck for Postage."

Editor American Machinist:

We would like to ask whether other parties than ourselves have been favored with applications for advertisements from an English paper known as the *Board of Trade Journal*, and stuck for postage as we have been. Three times we have had applications from this party, without any indication upon the outside of the envelope as to whom it was from. Once we were compelled to pay 32 cents postage, once 54 cents postage, and this week have been called upon for a 32 cent item. The journal uses a two-penny stamp only, and incloses an envelope with an English one-penny stamp upon it, and wants a reply.

WATSON & STILLMAN.

A Cleveland, Ohio, dispatch says: A new astronomical instrument, termed a sextuple photographic telescope, has just been completed by Warner & Swasey, of this city, and is about to be shipped to New Haven, Conn. It will be placed in one of the Yale observatories, and though intended for general astronomical photography, will begin its picture-taking with the appearance of the August meteoric displays. In certain respects it is unique among photographic telescopes, and may revolutionize present methods of work. It has six cameras instead of one, and together they cover a field in the sky equal to that which would be occupied by 2,400 full moons. By the use of the new instrument on the meteors it is expected to develop new facts relating to their height above the earth. The astronomers will place single telescopes at distances of two miles from the sextuple instrument and by means of electrical connections will photograph simultaneously. The plates will then be compared and calculations will be made with a view of establishing the distance of the meteors from the earth.

It is said that the Midvale Steel Works have a new process of making armor plates, which will enable them to stand much more severe tests than any to which the Harveyized plates have been subjected.

As a train on the Central Division Railroad passed through a city near Rising Sun, Md., a few days ago, a two-year old boy was on the track. Bewildered when the engineer gave the warning signal, the child continued on the track, the train running so fast that to stop it in time was impossible. The fireman, named Nelson, sprang through the lookout window, ran along the footboard, and, swinging from the pilot table, kicked the child in the forehead, and knocked it into the ditch along the track. The train was stopped, the crew went back and carried the limp form into its home. The grandmother met them and fainted at the sight of the little one in strange arms. On the return trip the train stopped, and the little fellow was found playing in the yard, on his forehead the mark of the fireman's shoe, made when he kicked him over and saved his life.—*Baltimore Sun.*

Bicycles are geared usually to 60 inches or 64 inches and racing machines 70 inches to 80 inches, and racers therefore do not have to move their feet at a rate of anything like seven strokes per second in order to go a mile in 1 minute 56 seconds, as it has been assumed they do by one of our worthy contemporaries.

The East River tunnel, which was recently formally opened, is 2,516 feet in length, oval shaped, 8 feet 6 inches high, and 10 feet wide. It runs under Blackwell's Island.

There is a very decided exodus of workingmen from this country to Europe just at present. This exodus may go on for a good while to the advantage of this country. It should be published all over Europe that the conditions here are substantially the same as there, viz., more men looking for work than there is work to do. Men coming from Europe to this country in search of work are very likely to jump from the frying pan into the fire. They are almost certain to do so. This condition is bound to be righted here, but in the intervening time there is likely to be much suffering. It is better for a workingman in Europe who has the price of a ticket to this country to spend his money for bread and butter, than to invest it in a ticket. And this is likely to be true for some time to come.

A Joliet, Ill., dispatch says: When the late George Stewart, of Wilmington, died, he had many thousand dollars' worth of securities, money, etc., locked up in his safe, of which he alone had the combination. When the executor, M. N. M. Stewart, came to administer the estate, he could not get into the receptacle holding the valuables. After consulting Warden Allen, Mr. Stewart sent the safe to the prison. The most expert safe-cracker in the country, who is serving a long term, was shown the safe, and, walking up to it, looked it all over. "Can you open safes?" he was asked.

"That's what got me in here," the convict replied.

He was handed a chair and seated himself in front of the door, giving the handle several lively twists. Then he began a job that occupied over an hour's time, but which ended in his throwing the door wide open.

The late Horace Greeley once assured a candidate for the Presidency that he stood no better chance of being elected than he did of being struck twice by lightning during the continuance of a single thunderstorm. Strange as it may appear, this last actually happened recently in a Western town, and the man operated upon is still alive.

A British Royal Commission has recommended that blasting with gunpowder in coal mines be prohibited. Experiments were made which demonstrated the danger of dust explosions from such blasting.

A suit has been begun against the Southern Pacific Railroad Company, in the United States Circuit Court at Los Angeles, Cal., by United States District Attorney Denis The object of the suit is to annul all agreements between that company and some five other companies, compelling each company to operate its own line. The bill is also directed against the Pacific Mail Steamship Company to separate that company from the railways. The suit is brought under the anti-trust law of 1890, and is undoubtedly brought in answer to a strong feeling against the Southern Pacific monopoly. The fact that it is brought just at this time is considered significant.

A writer in the *Railroad Gazette*, who signs himself "Land Lubber," is given a leading position in which to tell what he does not know about the engines of Western river boats. He says:

A cam motion to operate the valves is the universal practice. The valves are set when the engines are built, and are not changed till worn out. The valves are generally set so that steam will be admitted to the cylinder when the piston has moved about 12 inches on the return stroke. The necessity for this, as explained by a marine engineer, is "so that in starting we can make her smarter by raising the cam." It is often necessary to raise the cam by hand to have her start at all. When the cam is raised, steam is admitted at the beginning of the stroke. If the cam were secured in the higher position for the go-ahead, it would be so much the worse for the backing position. It is very uncommon to find an engine on these boats that is not using steam at boiler pressure throughout $\frac{3}{4}$ or $\frac{7}{8}$ of the stroke, and exhausting the steam at a pressure of about 100 pounds per square inch.

Comment on the foregoing would be quite superfluous.

The sugar trust has just been fined $200 in Boston for some sort of crooked work. It is thought it will continue in business, notwithstanding.

The sections of large fly-wheels are held together by bolts, keys, links and analogous means, and should be regularly inspected to see that none of the fastenings are loose. In one instance a wheel 25 feet in diameter with a peripheral velocity of 5,283 feet per minute, run for some years quite open to inspection. It was then closely boxed in, and in about a year went to pieces, doing considerable damage to the mill, but, fortunately, injuring no one. It was always believed that the accident was caused from some of the fastenings getting loose.

MANUFACTURES.

At Rockingham, N. C., the Midway Cotton-mill is erecting an addition to its plant.

The McColl (S. C.) Manufacturing Co. will add new machinery to its plant shortly.

The Johnson, Rand & Caruthers Shoe Co. has been organized in Memphis, Tenn.

The Perfection Shoe Co. has been organized at Portland, Me., with $10,000 capital.

E. W. Gilfillan, of Sheffield, Ala., will establish a wood-working plant at Pine Bluff, Ark.

The Lindell Railroad Company, of St. Louis, Mo., will erect a $16,000 electric-power plant.

The Keene Machine Co. has been incorporated at Dallas, Tex., by M. W. Kane and others.

J. M Burrows is interested in an electric-light plant to be established at Hawkinsville, Ga.

The Morton Tin Plate Co., Cambridge, O., has been formed with a capital stock of $100,000.

Barraclough & Berkenstein will establish a woolen and shirt waist factory at Fostoria, O.

The Laconia (N. H.) Car Company will at once rebuild the recently burned portion of its plant.

The Pittsburgh Wire Works, at Braddock, Pa., are now running in all departments, double turn.

The work of converting the Bessemer (Ala.) rolling mill into a steel plant has been commenced.

A new set of machinery, cards, spinning, etc., is to be placed in the new Riverside Mill, Lebanon, N. H.

The Portland, Me., Wringer Co. has been organized to make wringers, etc., with $100,000 capital stock.

The Oakland Paper Co., of Manchester, Conn.,

HYDRAULIC DAMPER REGULATOR.

This is a new damper regulator which works by water pressure. Price, nickel plated, with chain and bracket, $125. Write for discounts. Guaranteed as sensitive and reliable as any.

MASON REGULATOR CO., Boston.

BUFFALO DRILLS. For Blacksmith, Carriage & Wagon Manfrs. 24 Sizes. Buffalo Forge Co. Buffalo, N.Y. U.S.A.

Chicago Office, 22 and 24 West Randolph Street.

BUFFALO FORGES. Americas Best. The World's Standard. Buffalo Forge Co. Buffalo, N.Y. U.S.A.

Here's a Lathe We're Proud Of!

And what's better, our customers are always highly pleased with our tools; the workmanship, material and finish are of the highest order, while our designs are the latest and most approved. We are quoting specially low prices just now. Our catalogue will tell you all about our tools—sent free.

SEBASTIAN LATHE CO.,
117-119 CULVERT ST., CINCINNATI, OHIO.

BORING AND TURNING MILLS.

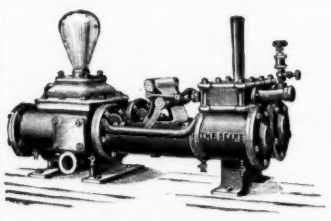
37, 51 and 62-Inch Swing, with Two Regular Heads.

42-INCH SWING, WITH TURRET HEAD, AND SCREW CUTTING ATTACHMENT.

All gears accurately cut. All feeds positive.

Machines are self-contained and therefore do not require an expensive foundation.

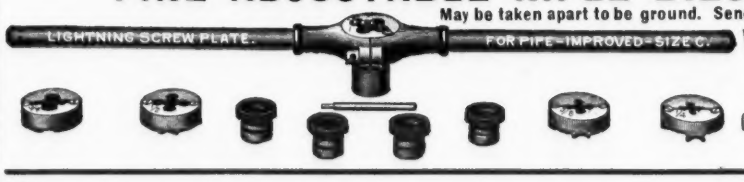
BRIDGEPORT MACHINE TOOL WORKS,
E. P. BULLARD, Prop. BRIDGEPORT, CONN.
New York Office, 86 LIBERTY STREET.



THE DEANE OF HOLYOKE STEAM PUMPS
DEANE STEAM PUMP CO.,
HOLYOKE, MASS.

CRESCENT STEEL. Established 1865 * Incorporated 1889.
CRESCENT STEEL CO.
480 Pearl St. New York. Pittsburgh, Pa. 64 & 66 S. Clinton St. Chicago.

FINE ADJUSTABLE RIFLE DIES.
May be taken apart to be ground. Send for catalogue.



Wiley & Russell Mfg. Co. Greenfield, Mass., U. S. A.

"R. MUSHET'S SPECIAL STEEL"
SAVES LABOR in being able to run at GREATLY INCREASED SPEEDS. FEWER GRINDINGS. No WASTE in redressing.
Sole Representatives in the United States.
B. M. JONES & CO.,
BOSTON: 11 & 13 Oliver St., NEW YORK: 143 Liberty St.

GRANT GEARS
Ready Made Cut Gears.
Ready Made Cast Gears.
Ready Made Brass Gears.
Gears Made to Order.
Gear Cutting.
Gear Book, 15 cents.
Treatise on Gears, $1.00.
Gear Cutting Machines.
GEORGE B. GRANT,
Lexington, Mass.,
and 125 South 11th St.,
Philadelphia, Pa.

THE GAS ENGINE,
History and Practical Working,
BY DUGALD CLERK.
With over 100 engravings. 12mo, cloth. $2.00.
JOHN WILEY & SONS, NEW YORK.

ASBESTOS SMOKE STACK PAINT
Used on the ships of the U.S. Navy and by the prominent Steamboat and Transportation Companies. The only paint supplied in colors which has given absolute satisfaction where forced draught is used.
READY FOR USE. ALL ORDINARY SHADES.
H. W. JOHNS MFG CO. 87 MAIDEN LANE, NEW YORK.
New York Jersey City Chicago Philadelphia Boston London

is building an addition of brick 40x60 feet, three stories.

The Lalance and Grosjean Co. will shortly add a large tin-plate plant to its rolling-mill at Harrisburg, Pa.

The scale for the Bay View Works of the Illinois Steel Company has been signed and 600 men resumed work.

The Oakland Paper-mill, at Manchester, Conn., is being enlarged by an addition 40x60 feet, three stories high.

A building is being erected in Foxboro, Mass., for the Van Choate Electric Co. It will include a lamp factory.

The Witherell Shoe Co. is to establish a factory at Whitefield, N. H., the citizens pledge $5,000 to the enterprise.

The Anti-slip Horse Shoe Co. is a new concern in New York; capital, $100,000; incorporators, Emil Rinke and others.

W. & D. Mogey, Bayonne, N. J., issue a catalogue of astronomical telescopes and photographic lenses made at their works.

It is stated that the tube shop at the General Electric Works, Schenectady, N. Y., recently burned, will be rebuilt.

The Electric Boiler Co. has been formed in Rochester, N. Y.; capital, $50,000; incorporators, J. H. Howe and William T. Bassett.

The Harrisburg (Pa.) Rolling-mill Company has notified its puddlers that their wages will be increased from $2 50 to $2.75 per ton.

It is reported that the Howard-Harrison Iron Co., Bessemer, Ala., will double the capacity of its general foundry and machine shop.

The Ellicott Electric Heating Co., capital $25,000, has been formed in Buffalo, N. Y., to manufacture machinery, generators, motors, lamps, etc.

The Samuel Winslow Skate Manufacturing Co., Worcester, Mass., is to erect a new power house 66 feet long by 40 feet wide, with a monitor roof.

Enlargements will be made to the plow factory of J. I. Wells & Sons, at Jackson, Tenn., so that agricultural implements of all kinds will be made.

The new cruiser "Minneapolis" is equipped throughout with the Foster pressure regulator, made by the Foster Engineering Co., of Newark, N. J.

The plant of the American Optical Co., of Southbridge, Mass., is to be enlarged by the erection of a new engine and boiler house of brick, and a new chimney.

The new Howland Falls, Me., Pulp Co. mills will be built of brick and will be larger than the old plant. They will have a capacity of 30 tons of pulp daily.

The erection of the Howard machine shops at Bartow Fla., is assured. They will consist of building 40x60 feet, foundry 40x40 feet, blacksmith shop 15x15 feet.

A large steam saw-mill is to be built this summer at West Cove, Me. The Gerrish Brothers, associated with J. H. Eveleth, of Greenville, will operate the mill.

The Waterford Manufacturing Company, South Waterford, Me, have their chain factory nearly completed. A large part of the machinery is already in position.

The Poppowitsch Electric Co. will locate in Allingtown, Conn. Most of the stock of the company has been subscribed for in New York, and it said that about 500 men will be employed.

The rolling-mill at Burlington, Ia., owned by Youngstown (O.) capitalists, has been sold to the Western Iron and Steel Company, of Tacoma, Wash., to which place it will be moved.

The American Skewer Co., of Jackson, Tenn., will commence work on its buildings at once. The main building is to be of brick, three stories high, 60x171 feet, engine and boiler room, 37x50 feet, etc.

The Buhl Stamping Co., Detroit, Mich., has issued a very neatly illustrated catalogue of tubular lanterns and lamp goods, supplemented with cans and other articles manufactured by the company.

Dean Bros., Indianapolis, Ind., are getting the new machinery into their new shops, on First street and the Big Four tracks, and expect to begin operations in the new works early in August.

The Rice & Sargent Engine Co. has been incorporated in Providence, R. I., to manufacture steam engines and other machinery. The officers are: R. A. Robertson, president; Z. Chafee, vice-president; John W. Sargent, secretary, and Richard H. Rice, treasurer.

W. C. Dewey, of Palmer, Mass., has sold the wire-mill property to Hermann Bauman and Jacob Mueller, of New York. The property consists of a large mill, and 35 acres of land. Work has been commenced, and it is thought that the plant will soon be in full operation.

Extensive improvements are being made in the plant of the McCullough Iron Company, at North East, near Wilmington, Del. Several oil-burning furnaces are being put in, and a tank to hold 25,000 gallons is in the course of construction for the purpose of supplying the oil to the furnaces.

The Windsor Locks (Conn.) Steel Company is advertising its mill and other property for sale. A large amount of new material and appliances was put into the mill during the two years previous to last October, when the breaking of a large flywheel wrecked a portion of the works. The company was soon after put into a receiver's hands.

The Sebastian Lathe Co., Cincinnati, O., has issued a new and enlarged catalogue of machinery, tools and supplies, including engine and speed lathes which they manufacture, and machinists' tools and supplies generally, for which they are agents. The catalogue is freely illustrated.

An Eastern branch office of the Harrison Safety Boiler Works has been established at No. 19 Pearl street, Boston, Mass., Sumner B. Merrick in charge. Inquiries addressed to this office for information and estimates on any of the company's specialties will receive the same attention that they would if addressed to the general office.

The Cochrane Separator is the title of a new circular issued by the Harrison Boiler Works, Philadelphia, Pa. The Cochrane separator is a device for separating water from steam before the latter reaches the engine, the object of doing so being well understood by engineers. Incidentally, oil as well as water is separated from the steam.

Chandler & Taylor, Indianapolis, Ind., recently received an order for the boiler, tanks, etc., for a 50-ton ice plant that Mr. Eugene Berkley, of this city, is to erect in Terre Haute for the Vigo Ice and Cold Storage Company. By the terms of the contract the plant must be ready to manufacture ice in thirty days from date of receiving the order.

The M. Rumely Company, Indianapolis, Ind., manufacturers of engines and threshers, which a few months ago purchased the ground on the northwest corner of Georgia and Tennessee streets, will in a short time tear down the old frame building and erect a handsome building. Indianapolis has now become the company's most important distributing point.

The Sheffler Bridge Company, Pittsburgh, contracts to build a rolling-mill 292x142 feet for the Logan Iron and Steel Company, at Burnham, Pa.; wheel shop, machine and producer shops and power house for the Standard Steel Works, at Burnham, Pa., and for an extension to the open-hearth building of the Lukens Iron and Steel Company, at Coatesville, Pa., which will be 100x105 feet in size.

In calling attention to a 200-page catalogue, F. E. Myers & Bro., manufacturers of pumps and hay tools, write us: "While trade conditions and results have been unsatisfactory, we have run full force, and unless present strike shuts off supply and outlet entirely, we will continue to run through the entire year. We consider this a compliment and substantial evidence that the Myers pumps and hay tools possess merit and have a trade reputation that is substantial."

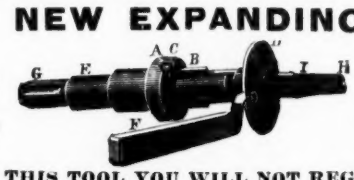
The Berlin Iron Bridge Co., of East Berlin, Conn., have received the contract for a new electric light and power station for the Bradford Electric Light and Power Co., at Bradford, Pa. The building is 65 feet wide and 160 feet long, with brick side walls, the roof being of iron, covered with the Berlin Iron Bridge Company's patent anti condensation corrugated iron roof covering. When completed, this will be one of the finest and most complete stations in western Pennsylvania, and also so constructed as to be absolutely fire-proof, there being no woodwork about the building to take fire.

The directors of the Rome (N.Y.) Locomotive and Machine Works have elected the following officers: President, Thomas H. Stryker; vice president, William B. Isham; secretary and treasurer, Edward Comstock; executive committee, Messrs. Stryker, Comstock and Isham. The work of rebuilding the planned portion of the company's buildings is progressing satisfactorily and will probably be completed this fall. Meantime the company is turning out different classes of machine work, being also prepared to do locomotive building and repairing if there shall prove to be a demand for that class of work.

The A. T. Atherton Machine Co. and William H. Goldsmith, of Pawtucket, R. I., have disposed of all their interest in and to the patent granted to William H. Goldsmith for metallic drawing rolls, to the Pawtucket Metallic Drawing Roll Co., which is a new corporation lately organized in Pawtucket, under the laws of the State of Rhode Island. This company is now making special tools for manufacturing these patent drawing rolls, and as soon as completed they will be in a condition to put their rolls upon the market. The

LECOUNT'S NEW EXPANDING MANDREL.

Amateur's Size.
Taking anything from ⅛ to 1 inch inclusive.
Price.....$5.00
Patented Dec. 25, 1877.



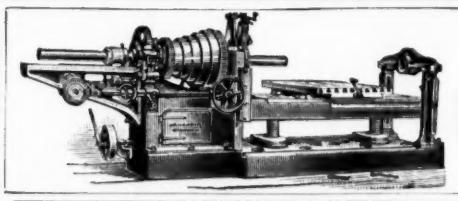
Machinist's Size.

No.		Price.
1	⅛ to 1 in.	$10
2	1 " 1½ "	14
3	1½ " 2 "	18
4 (with screws)	2 " 3 "	32
5 " "	3 " 4 "	44

IF YOU WILL TRY THIS TOOL YOU WILL NOT REGRET THE EXPENSE.
C. W. LECOUNT, SOUTH NORWALK, CONN.
SPECIAL MANDRELS FOR SPECIAL JOBS MADE TO ORDER.
These goods are for sale by CHAS. CHURCHILL & CO., L't'd. 21 Cross St., London, England.

DON'T ACCEPT ANY SUBSTITUTE FILE.
INSIST ON HAVING NICHOLSON.

NICHOLSON FILE CO.
PROVIDENCE, R. I., U. S. A.
3000 VARIETIES FILES
[X. F.] & INCREMENT CUT FILES.

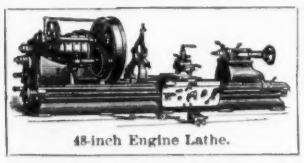


BETTS MACHINE CO.,
WILMINGTON, DEL.
MACHINE TOOL BUILDERS.
Improved Patterns! Late Designs!

"Star" Foot Lathe Swings 9x25 in. | LATHE | Screw Cutting Automatic Cross Feed, etc.
Scroll Saws, Circular Saws, Lathes Mortisers. | LATHE | Catalogue Free of all our Machinery.
Seneca Falls Mfg. Co., 687 Water St., Seneca Falls, N.Y

JESSOP'S STEEL
FOR TOOLS, DRILLS, DIES, &C.
ALL KINDS IN STOCK.
Manufactory, SHEFFIELD, ENG.
Chief Am. Office, 91 JOHN ST., N. Y.
WM. JESSOP & SONS, LTD.
Established a century ago.
Medal World's Columbian Exposition 1893.

FITCHBURG MACHINE WORKS,
MANUFACTURERS OF THE CELEBRATED
FITCHBURG MODERN ENGINE LATHE
AND OTHER METAL-WORKING MACHINES
SEND FOR CATALOGUE E.


48-inch Engine Lathe.

FITCHBURG, MASS.

BUILDERS IRON FOUNDRY,
FOUNDERS AND MACHINISTS,
PROVIDENCE, R. I.
Orders are solicited for machine work requiring accurate workmanship and large machine tools. Our equipment is probably superior to that of any shop in New England, employed chiefly for contracts or general jobbing. Small, as well as large orders receive careful attention, and we are prepared to assist machine shops which have tools smaller than our own.

ROBERTSON THOMPSON
$40.00

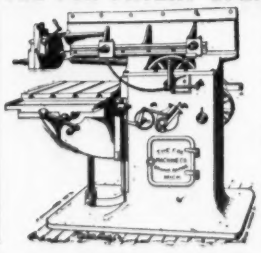
Y SHOULD U PAY
$85.00 for an Indicator when you can get either of these for $40.00, packed in finest cases, finest workmanship, finest material, and the **best** designs.
Send for circular of Reducing Wheels, Planimeters, Three-Way Cocks and 25 other high grade specialties.
HINE & ROBERTSON CO.,
61 Cortlandt St., New York.

IMPROVED Straight Line
$40.00

LATHES, PLANERS, DRILLS,
AND OTHER
IRON WORKING TOOLS.
Before ordering send us a memorandum of your requirements.
COOKE & CO.,
163 & 165 Washington St., NEW YORK.

HENRY CAREY BAIRD & CO.,
INDUSTRIAL PUBLISHERS, BOOKSELLERS AND IMPORTERS,
810 Walnut St., Philadelphia.
☞ Our New and Revised Catalogue of Practical and Scientific Books, 88 pages, 8vo., and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.

THE FOX PATENT OPEN SIDE SHAPER.



No springing of ram. No overhanging table. Quick Return. Stroke Under Perfect Control. Can be Instantly Adjusted 1 16 in. or 24 in. No Screws to Monkey with. Powerful, Quick, Accurate. Write for circular.
The Fox Machine Co.,
325 N. Front St.,
Grand Rapids, Mich.
135 Finsbury Pavement, London, England.

ROOTS' NEW ACME HAND BLOWER.
For Blacksmiths, etc. Slow Speed, Positive Blast. Is Durable, Compact and Cheap; also Portable Forges, Tuyere Irons and Foundry Blowers.

P. H. & F. M. ROOTS, Mfrs.
CONNERSVILLE, IND.
Chicago Office: 1405-10 MANHATTAN BUILDING.
S. S. TOWNSEND, Gen. Agt. } 163 & 165 Washington St., NEW YORK.
COOKE & CO., Selling Agts. }
Please Mention This Paper.

WORTHINGTON STEAM PUMPS
FOR ALL DUTIES.

HENRY R. WORTHINGTON,
NEW YORK, 86 and 88 Liberty St.
BOSTON, 70 Kilby St.
PHILADELPHIA, 607 Arch St.
CLEVELAND, 24 South Water St.
CHICAGO, 185 to 189 Van Buren St.
ST. LOUIS, Eighth and St. Charles Sts.

company now have a number of orders on hand, and expect to do a large business in this line.

The proprietors of the Indiana Bicycle Company and of the Central Cycle Company, Indianapolis, Ind., state that the first six months of this year they manufactured and sold more bicycles than ever before in a like period. The Indiana Bicycle Company last Thursday turned out the ten thousandth bicycle manufactured since January 1, 1894, and have had no trouble in disposing of their entire output. The Central Cycle Company has worked 30 more men than ever before, and has sold 25 per cent. more bicycles than in the first six months of 1893. In both cases a number of men were laid off on Saturday night, as the busy season with bicycle manufacturers ends with July 1st, but this year has run a little longer than usual. No effort will be made to push things until September 1st, then both will resume business with a full force. The Indiana Bicycle Company is building quite an addition to its already extensive plant.

Smith & Wesson have given to the Union Metallic Cartridge Company, of Bridgeport, Conn., the sole right to manufacture the self lubricating bullet, on which Smith & Wesson have patents for a term of 17 years. The invention, which was made by D. B. Wesson, was first patented a year ago, and within the past few months about 400,000 of the bullets have been made at the Smith & Wesson works for the foreign and domestic trade. The reason for the transfer of the manufacturing from Springfield to the Bridgeport Company is on account of the superior facilities the Union Metallic Cartridge Company possesses for making the bullets. A royalty will be paid Smith & Wesson from the sale, and the manufacture of the bullets will be actively pushed. At first bullets for Smith & Wesson revolvers will be made, but an extension of the plant is contemplated, in which the same kind of self-lubricating bullets will be made for rifles and larger arms.

It is now a very generally conceded point that the seasoning of lumber by the progressive "fan" system of dry kilns is the most efficient and economical. Very large kilns of this sort are no longer uncommon. It is seldom in very large dryers that anything but a three-quarter housing fan is employed. With this style of fan the horizontal type of engine is used for driving same, and is readily accessible for oiling and repairs on account of the lower scroll of the fan being underground, bringing the engine down low. The Menasha Wooden Ware Co., Menasha, Wis., who employ in their plant over a dozen dryers, find it impossible to install a three-quarter housing fan for the reason that their kilns for the most part are located on spiles driven into low marshy ground; in fact, close up to the water's edge, in order to facilitate handling the green timber. The largest full housing fan ever employed for a lumber dry kiln was purchased by them of the Buffalo Forge Co., Buffalo, N. Y., about three months ago. The fan stands 150 inches in height, and is supplied with a direct-acting 10x10 cylinder engine, the working parts being entirely inclosed. A heater containing 14,000 lineal feet of one-inch pipe is used in conjunction with the above fan. Although this engine runs continuously, and upon a foundation anything but solid, highly satisfactory results are obtained. The Menasha Wooden Ware Co. have just ordered of the Buffalo Forge Co. a duplicate of the above plant, in which they state as follows: "From the fact of our giving you a further order, you can imagine that we are pretty well pleased with the apparatus that we now have." The apparatus referred to is the first Buffalo kiln installed in their works, although they have been using the "fan" system for a number of years.

Machinists' Supplies and Iron.

NEW YORK, July 21, 1894.

Iron—American Pig—We quote standard brands, $12.50 to $13 for No. 1; $11 to $12 for No. 2. Southern brands, $11 50 to $12.25 for No. 1; $10.50 to $11 for No. 2; $10 to $10 25 for No. 3; $10.50 to $11 for No. 1 soft; and $10.25 to $10.75 for No. 2 soft. Foundry No. 4, $9.75 to $10 25.

Antimony—We quote L. X., 8⅝c. to 8¾c.; Cookson's, 9¼c. to 10c.; Hallett's, 8.25c. to 8.50c; and U. S. French Star, 10c.

Lard Oil—We quote 55c. to 57c., according to quantity.

Copper—The market is dull. We quote Lake Copper at 9¼c.; probably less will buy. Casting is held at 8⅝c. to 8.70c.

Lead—The market is firm, with a fair demand for spot at 3.50c. August and September lead can be bought cheaper, at 3.40c. to 3.45c.

Spelter—The market is unsettled. There are scarcely any buyers. Western Spelter is quoted at 3.12½c. to 3.15c.

Tin—The market is weak. For spot and July delivery 19c. is asked, and 18.90c. bid.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—Situation by first-class pattern maker. Address B., AMERICAN MACHINIST.

Technical draftsman, with shop exp., good references, will go out of town for steady position. E. L., 3413 Third Avenue, New York, N. Y.

Designer and draftsman with technical education and experience in shop and drafting room, wants position. Box 119, AMERICAN MACHINIST.

An exp'd millwright foreman, good draftsman able to handle men and turn out work quickly, wishes to change his position. B. A., AM. MACH

Situation wanted as chief cost and time clerk, in factory employing about 150 men, to introduce piecework system. Box 125, AMERICAN MACHINIST.

Foundry engineer, German, 10 years' experience; prac. & theor. educated, desires a position in an iron foundry; A1 refs. Box 123, AM. MACHINIST.

A mechanical engineer with experience in designing fine machinery and special tools for reducing the cost of manufacture, is open for an engagement. Box 124, AMERICAN MACHINIST.

Position as assistant supt. or foreman, by exp'd energetic man, well up in milling machine practice, use of jigs and fixtures; can handle men to best advantage; best refs. A. F., AM. MACHINIST.

Wanted—First class millwright draftsman, with good education; one experienced practically at mill machine work preferred. Address with references, stating age, nationality and salary expected, "Draftsman," care AM. MACHINIST.

Wanted—By a millwright & machine concern in large Ohio river city, foreman for machine shop working from 4 to 8 men; only those with experience and ability to handle men and turn out work cheaply and rapidly need apply; Northern men preferred. Address, with particulars, stating age, nationality and experience, Foreman, care of AMERICAN MACHINIST.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Wanted—To buy good second-hand tools. Box 83, AMERICAN MACHINIST.

For Sale—Tools and machinery for light manufacturing. Address Machinery, Elgin, Ill.

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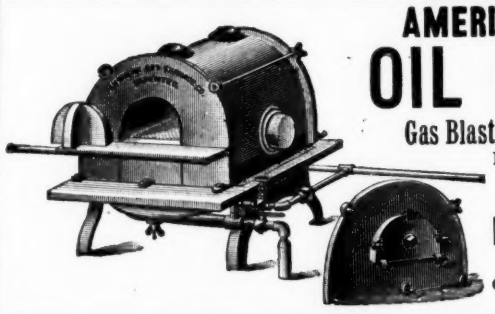

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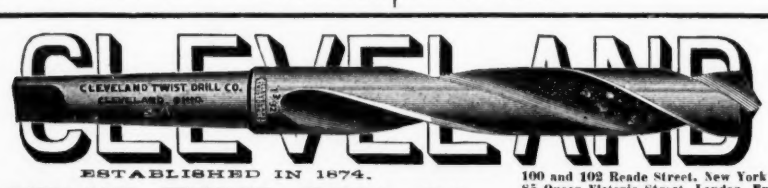

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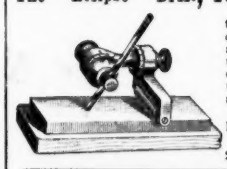
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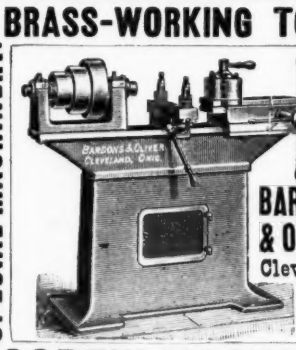

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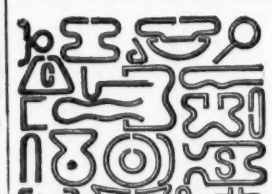
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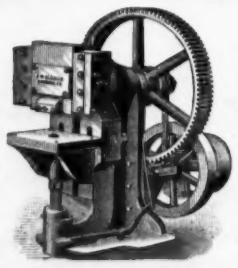
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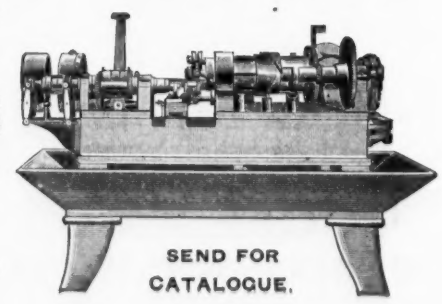
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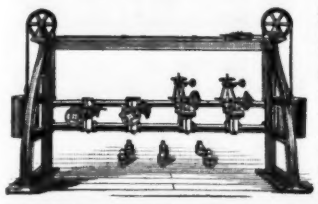

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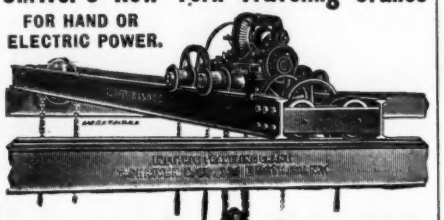

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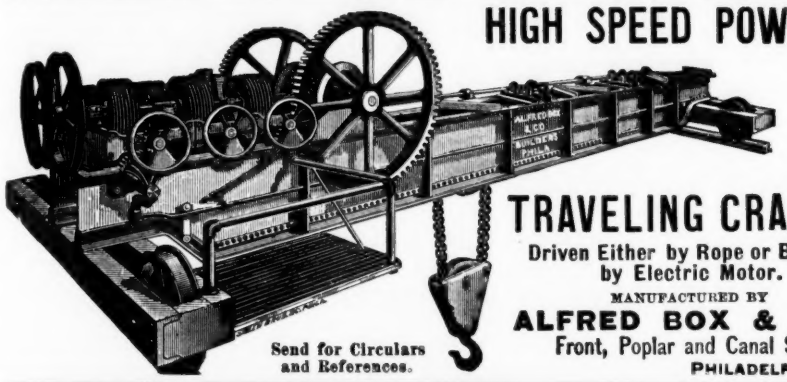

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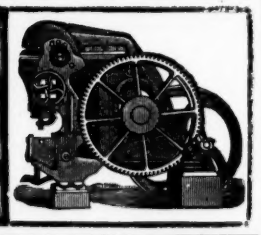

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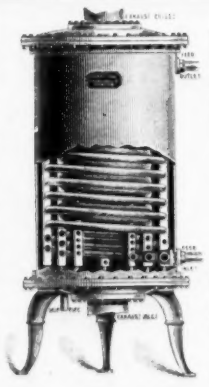

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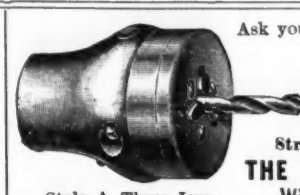

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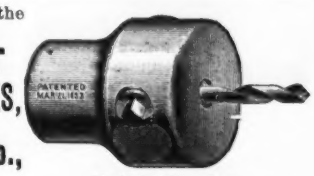

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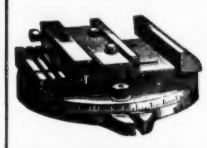

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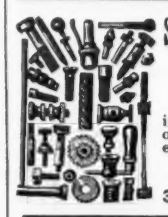

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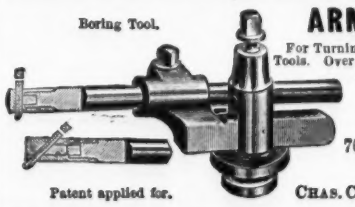

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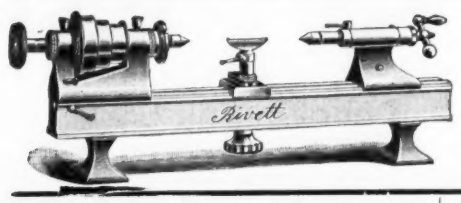

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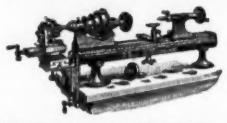

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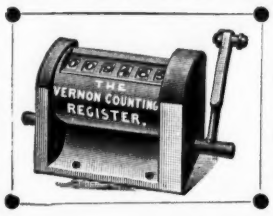

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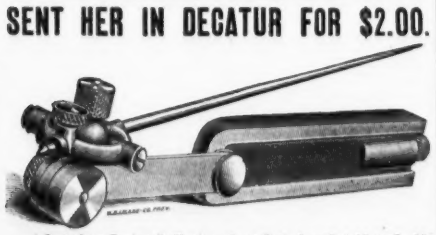

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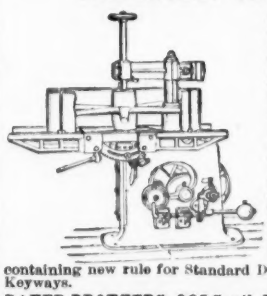

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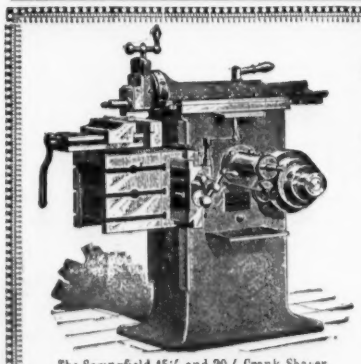

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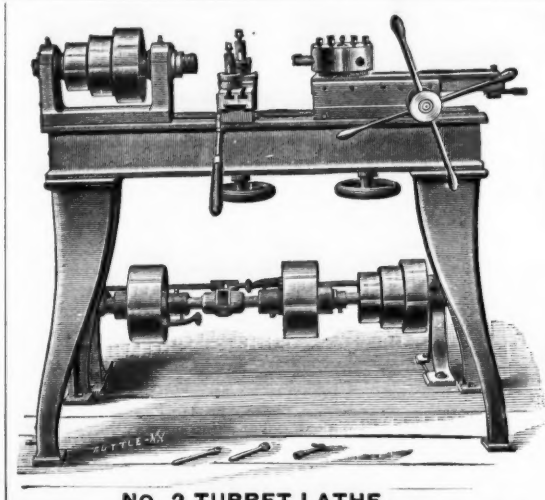

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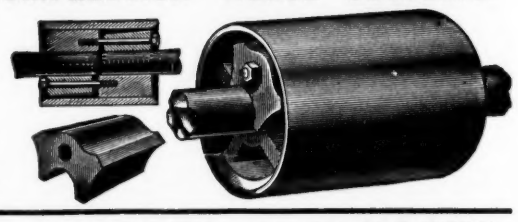

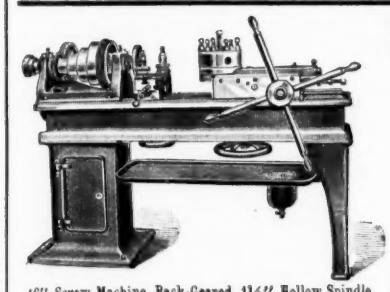

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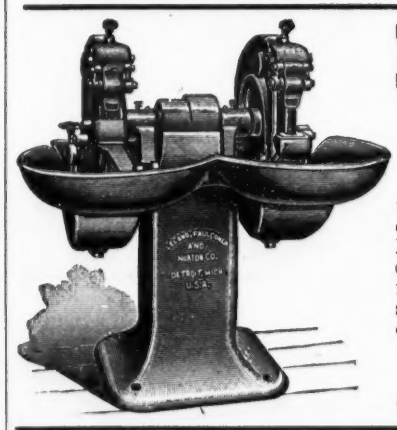

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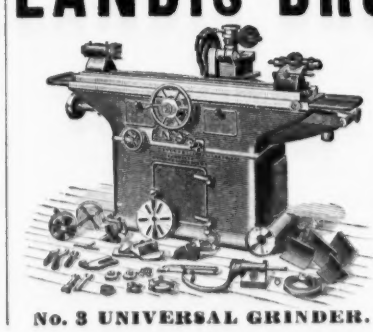

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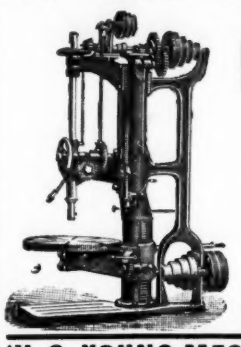

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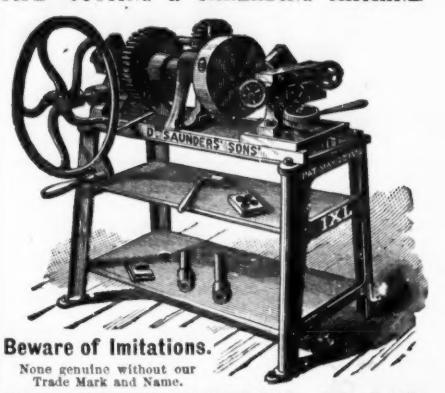

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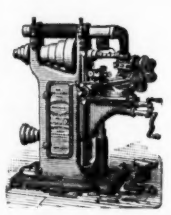

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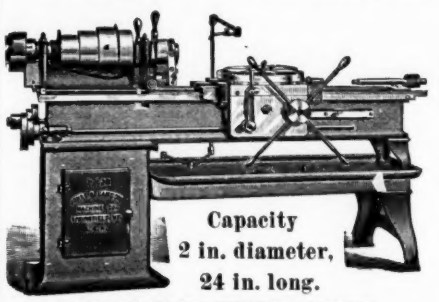

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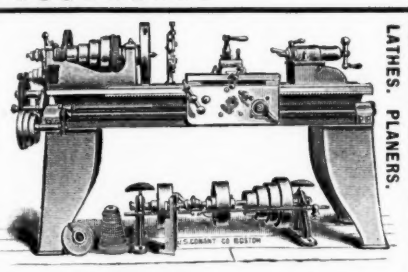

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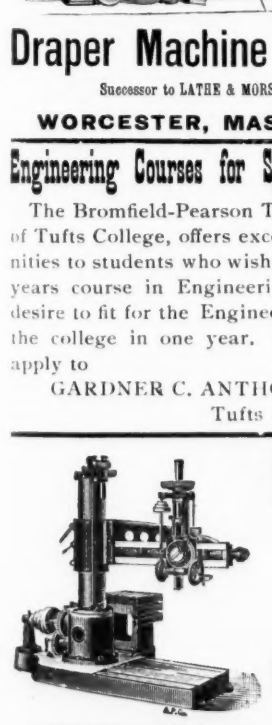

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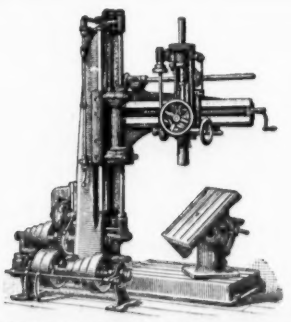

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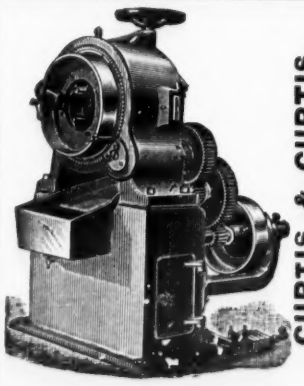

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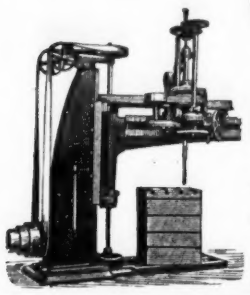

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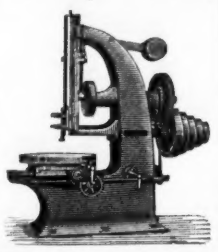

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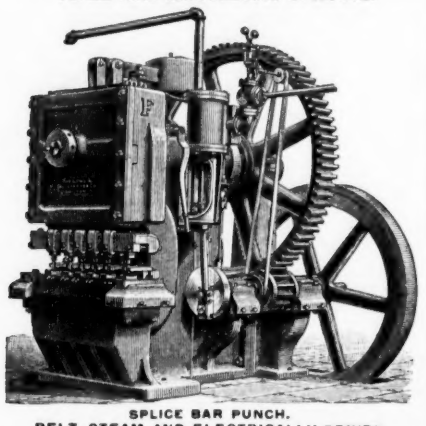

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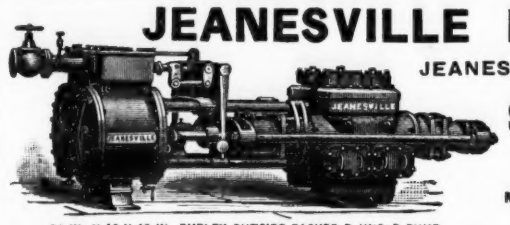

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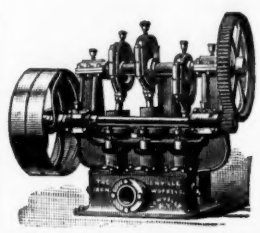

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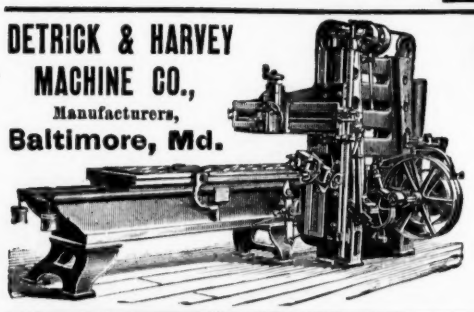

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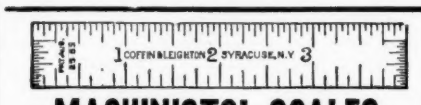

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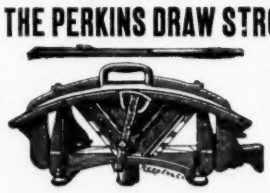

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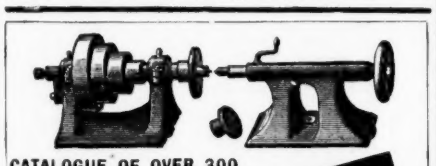

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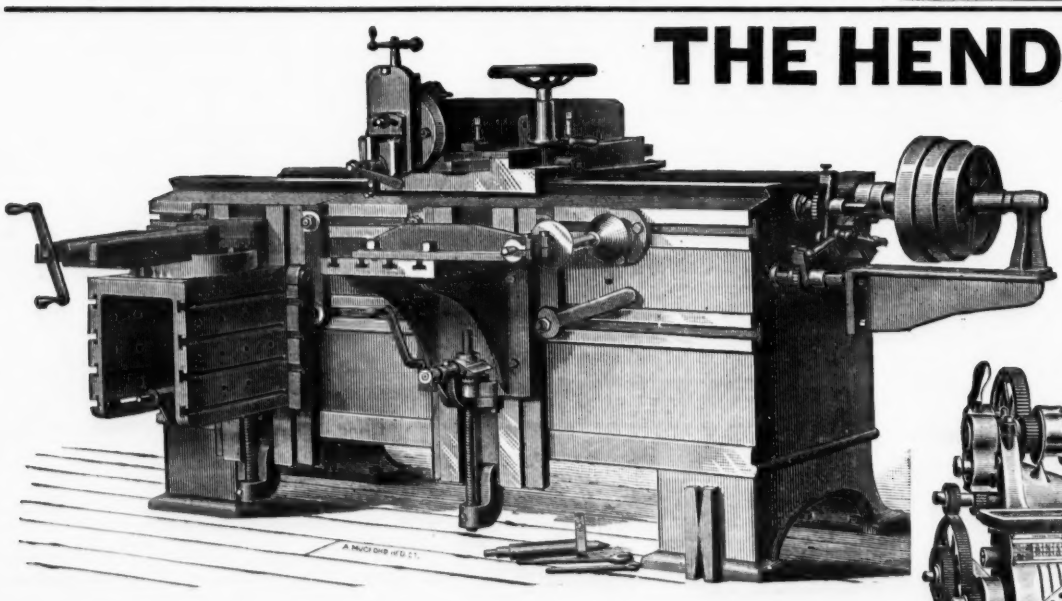

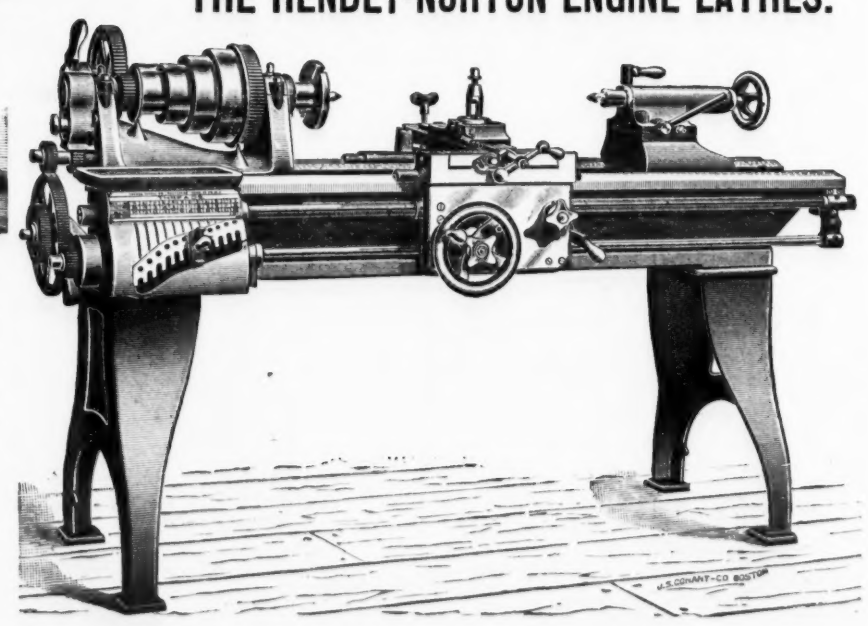

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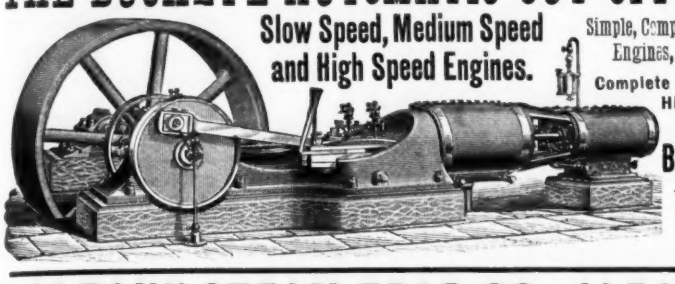

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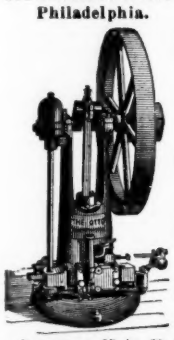

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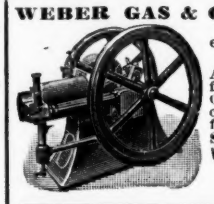

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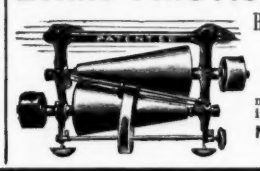

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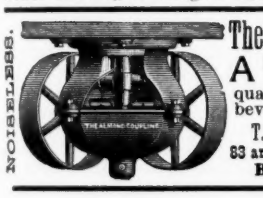

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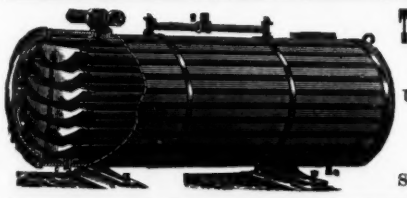

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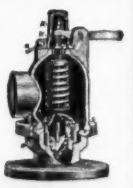

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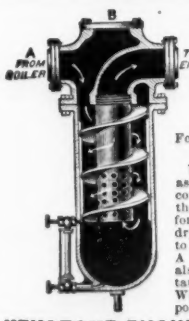

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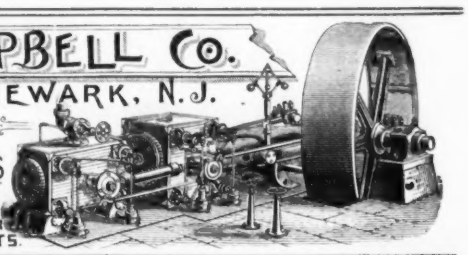

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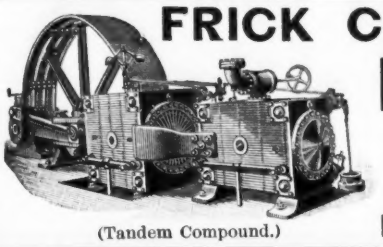

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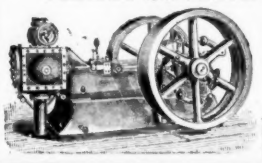

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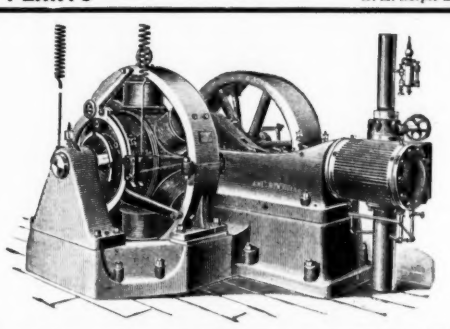

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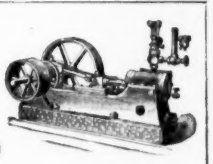

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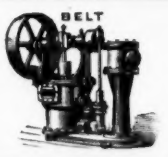

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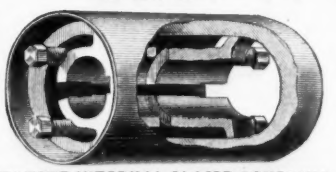

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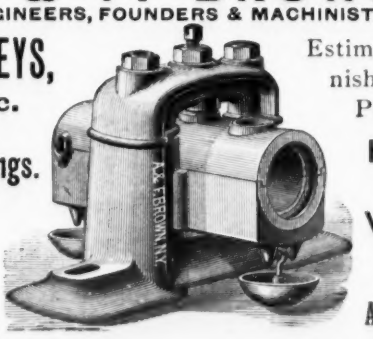

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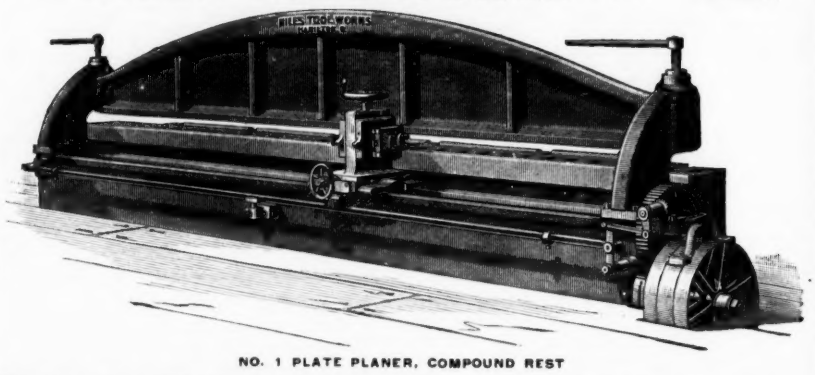

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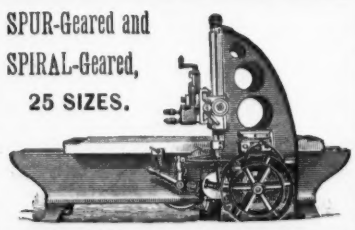

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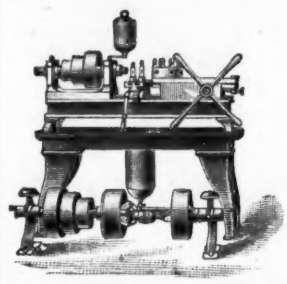

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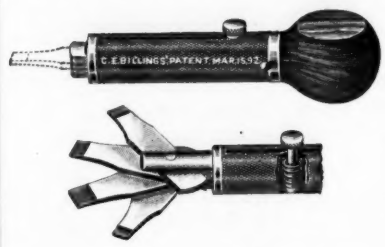

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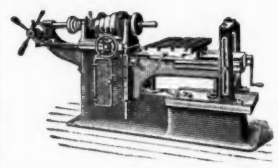

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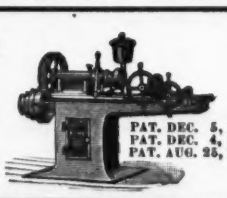

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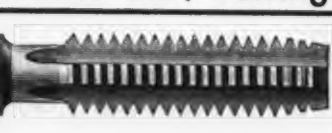

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